

PHYSICS

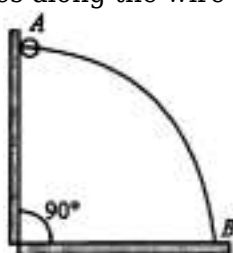
1) If speed (V), acceleration (A) and force (F) are considered as fundamental units, the dimension of Young's modulus will be :-

- (1) $V^{-2}A^2F^2$
- (2) $V^{-4}A^2F$
- (3) $V^{-4}A^{-2}F$
- (4) $V^{-2}A^2F^{-2}$

2) If $\vec{A} = \hat{i} + 2\hat{j} + 3\hat{k}$ and $\vec{B} = 2\hat{i} - \hat{j} + 2\hat{k}$, then find a vector whose magnitude is equal to component of A along B and direction is along $\vec{A}$.

- (1) $\frac{2(2\hat{i} + 2\hat{j} + 2\hat{k})}{\sqrt{14}}$
- (2) $\frac{2(2\hat{i} + \hat{j} + 3\hat{k})}{\sqrt{14}}$
- (3) $\frac{2(\hat{i} - 2\hat{j} + 3\hat{k})}{\sqrt{14}}$
- (4) $\frac{2(\hat{i} + 2\hat{j} + 3\hat{k})}{\sqrt{14}}$

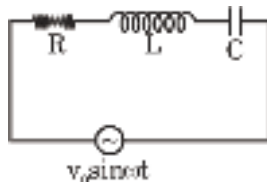
3) A wire, which passes through the hole in a small bead, is bent in the form of quarter of a circle. The wire is fixed vertically on ground as shown in the figure. The bead is released from near the top of the wire and it slides along the wire without friction. As the bead moves from A to B, The force it



applies on the wire is

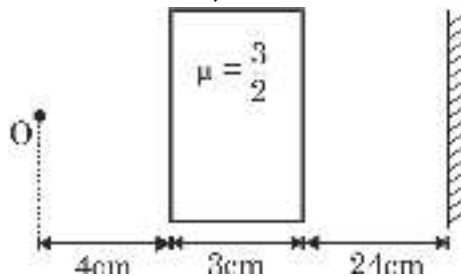
- (1) Always radially outwards
- (2) Always radially inwards
- (3) Radially outwards initially and radially inwards later
- (4) Radially inwards initially and radially outwards later

4) In RLC circuit as shown in the diagram, the maximum value of charge on capacitor is :-



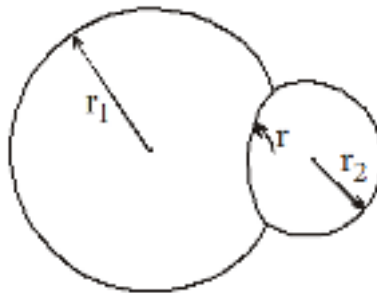
- (1) $\frac{v_0}{\omega Z}$
- (2) $\frac{v_0 R}{\omega Z}$
- (3) $\frac{v_0 \omega}{Z}$
- (4) $\frac{v_0 \omega R}{Z^2}$

5) A slab of thickness 3 cm and refractive index $\frac{3}{2}$ is placed in front of a plane mirror as shown in figure. A point object O is placed at a distance of 4 cm from the slab. After all possible reflections and refractions, the distance of final image of point object O from plane mirror will be :



- (1) 30 cm
- (2) 31 cm
- (3) 29 cm
- (4) 32 cm

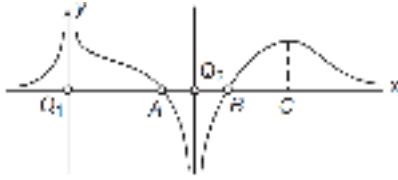
6) Two soap bubbles with radius $r_1 = 3\text{cm}$ and $r_2 = 2\text{cm}$ come in contact. Their common surface has



a radius of curvature r . Find value of r in cm.

- (1) 4 cm
- (2) 6 cm
- (3) 9 cm
- (4) infinite

7) The curve represents the distribution of potential along the straight line joining the two charges Q_1 Q_2 and (separated by a distance r) then which of the following statements are correct?



$$1. |Q_1| > |Q_2|$$

2. Q_1 is positive in nature
3. A and B are equilibrium points
4. C is a point of unstable equilibrium

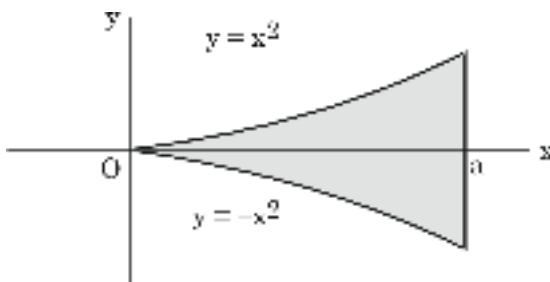
- (1) 1 only
- (2) 1, 2 and 3
- (3) 1, 2 and 4
- (4) 1, 2, 3 and 4

8) The length of a metal wire is ℓ_1 when the tension in it is T_1 and is ℓ_2 when the tension is T_2 . The natural length of the wire is

- (1) $\frac{\ell_1 + \ell_2}{2}$
- (2) $\sqrt{\ell_1 \ell_2}$
- (3) $\frac{\ell_1 T_2 - \ell_2 T_1}{T_2 - T_1}$
- (4) $\frac{\ell_1 T_2 + \ell_2 T_1}{T_2 + T_1}$

9)

The moment of inertia about x-axis of uniform thin plate of density $\rho \text{ kg/m}^2$ as shown in the figure is $\frac{N\rho a^7}{21}$, then find the value of N.



- (1) 1
- (2) 2
- (3) 4
- (4) 5

10) In a hydrogen atom, electron moves from second excited state to first excited state and then from first excited state to ground state. The ratio of wavelengths is -

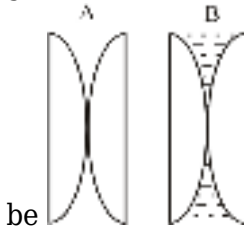
- (1) $\frac{20}{3}$

- (2) $\frac{15}{4}$
 (3) $\frac{27}{5}$
 (4) $\frac{5}{1}$

11) A radiator whose temperature is $T^\circ \text{C}$, is used to heat the room in the cold weather. The radiator is able to maintain a room temperature of 30°C when outside temperature is -10°C and 15°C when outside temperature is -30°C . Determine the temperature of the radiator [Assume Newton's law of cooling to be valid]

- (1) 85°C
 (2) 15°C
 (3) 98.6°C
 (4) 150°C

12) Figure A shows two identical plano-convex lenses in contact as shown. The combination has focal length 24 cm. Figure B shows the same with a liquid introduced between them. If refractive index of glass of the lenses is 1.50 and that of the liquid is 1.60, the focal length of the system in figure B will



- (1) -120 cm
 (2) 120 cm
 (3) -24 cm
 (4) 24 cm

13) The de-Broglie wavelength of a particle having kinetic energy E is λ . How much extra energy must be given to this particle so that the de-Broglie wavelength reduces to 75% of the initial value ?

- (1) $\frac{1}{9}E$
 (2) $\frac{7}{9}E$
 (3) E
 (4) $\frac{16}{9}E$

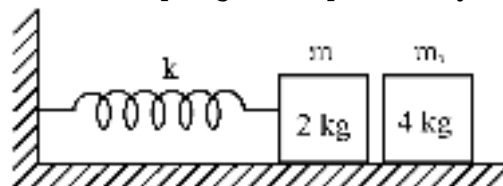
14) An open pipe is suddenly closed at one end with the result that the frequency of third harmonic of the closed pipe is found to be higher by 100 Hz than the fundamental frequency of the open pipe. The fundamental frequency of the open pipe is:-

- (1) 200 Hz
 (2) 300 Hz

(3) 240 Hz

(4) 480 Hz

15) Two masses $m_1 = 2 \text{ kg}$ and $m_2 = 4 \text{ kg}$ are placed on a smooth horizontal surface, with mass m_1 attached to a spring of spring constant $k = 600 \text{ Nm}^{-1}$ as shown in the figure with m_2 in contact with m_1 . If now both the masses m_1 and m_2 are pushed together so that the spring is compressed by $d = 5$



cm and then released. Choose the INCORRECT statements.

Statement (1): The maximum speed v_m of mass m_2 with respect to mass m_1 is 1 ms^{-1} .

Statement (2): The amplitude of oscillation of m_1 is $\frac{5}{\sqrt{3}} \text{ cm}$

Statement (3): The amplitude of oscillation of m_1 is $\frac{10}{\sqrt{3}} \text{ cm}$

Statement (4): The maximum kinetic energy of the mass m_1 is 0.25 J.

(1) Statement 1 and 2

(2) Statement 2 and 4

(3) Statement 3 and 4

(4) Statement 1 and 3

16) A fire hydrant (as shown in the figure) delivers water of density ρ at a volume rate L . The water travels vertically upward through the hydrant and then does 90° turn to emerge horizontally at speed V . The pipe and nozzle have uniform cross-section throughout. The force exerted by the water



on the corner of the hydrant is

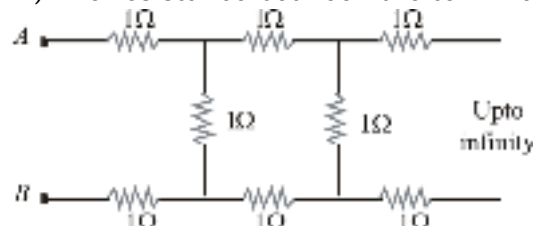
(1) ρVL

(2) zero

(3) $2\rho VL$

(4) $\sqrt{2}\rho VL$

17) The resistance between the terminal points A and B of the given infinitely long circuit will be :



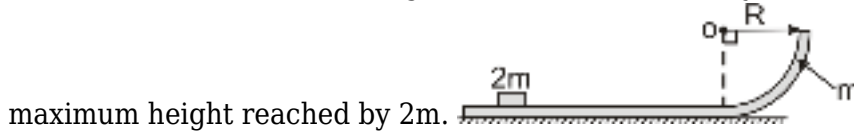
(1) $(\sqrt{3} - 1)$

(2) $(1 - \sqrt{3})$

(3) $(1 + \sqrt{3})$

(4) $(2 + \sqrt{3})$

18) Mass $2m$ is kept on a smooth circular track of mass m which is kept on a smooth horizontal surface. The circular track is given a horizontal velocity $\sqrt{2gR}$ towards left and released. Find the



maximum height reached by $2m$.

- (1) R
- (2) $R/3$
- (3) $R/4$
- (4) $2R/3$

19) A ball is projected from point A with velocity 10m/sec . perpendicular to the inclined plane as in

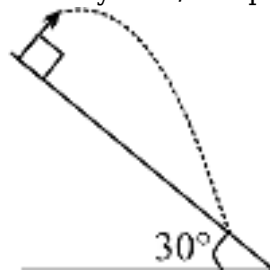
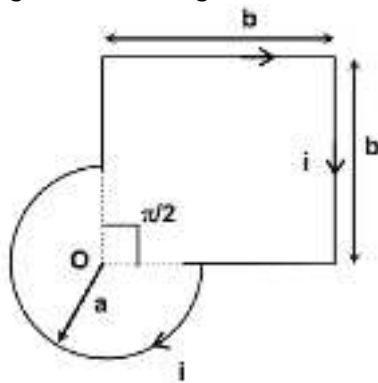


figure. Range of the ball on the incline is

- (1) $40\sqrt{3}\text{m}$
- (2) $20/13\text{ m}$
- (3) $13/20\text{ m}$
- (4) $40/3\text{m}$

20) Find the magnitude of magnetic field at O (centre of the circular part) of the current carrying

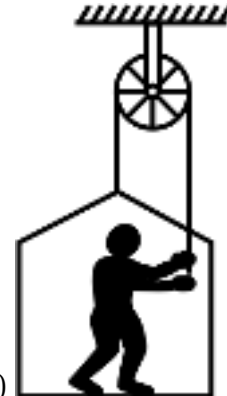


coil as shown.

- (1) $\frac{\mu_0 i}{4\pi} \left(\frac{3\pi}{a} + \frac{\sqrt{2}}{b} \right)$
- (2) $\frac{\mu_0 i}{2\pi} \left(\frac{3\pi}{2a} + \frac{\sqrt{2}}{b} \right)$
- (3) $\frac{\mu_0 i}{2\pi} \left(\frac{\pi}{3a} + \frac{3}{\sqrt{2}b} \right)$

(4) $\frac{\mu_0 i}{4\pi} \left(\frac{3\pi}{2a} + \frac{\sqrt{2}}{b} \right)$

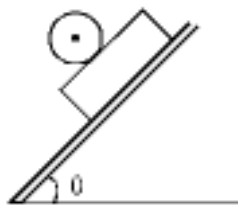
21) Figure represents a painter in a lift which hangs alongside a building. When the painter of mass 100 kg pulls the rope, the force exerted by him on the floor of the lift is 450 N. If the weight of the



lift is 25 kg, the acceleration of the painter will be : (Take $g = 10 \text{ m/s}^2$)

- (1) 1 m/s^2
- (2) 2 m/s^2
- (3) 3 m/s^2
- (4) 4 m/s^2

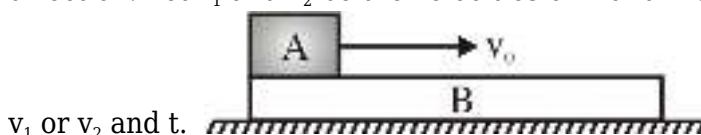
22) A plank of mass M is placed over smooth inclined plane and a sphere is also placed over the plank. Friction is sufficient between sphere and plank. If plank and sphere are released from rest,



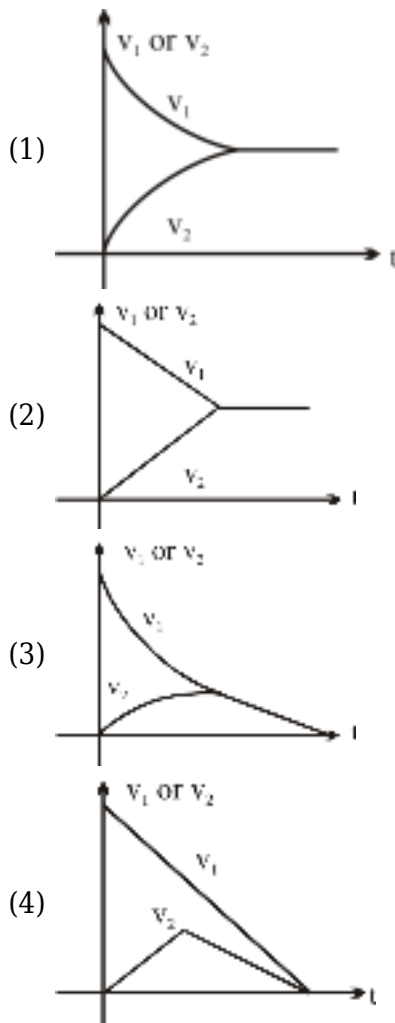
the frictional force on sphere is :-

- (1) up the plane
- (2) down the plane
- (3) horizontal
- (4) zero

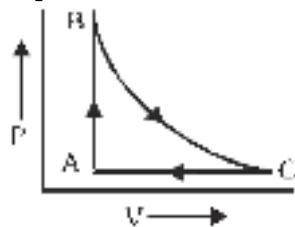
23) A block A is placed over a long rough plank B of same mass as shown in figure. The plank is placed over a smooth horizontal surface. At time $t = 0$, block A is given a velocity v_0 in horizontal direction. Let v_1 and v_2 be the velocities of A and B at time t . Then choose the correct graph between



v_1 or v_2 and t .



24) One mole of monoatomic ideal gas undergoes a cyclic process ABCA as shown in figure. Process BC is adiabatic. The temperatures at A, B and C are 300, 600 and 450 K respectively. Choose the



correct statement(s).

- (1) In process CA change in internal energy is $225R$.
- (2) In process AB change in internal energy is $-150R$.
- (3) In process BC change in internal energy is $-225R$.
- (4) Change in internal energy during the whole cyclic process is $+150R$.

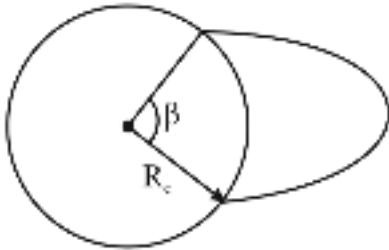
25) An unpolarized light is falling on a liquid surface 37° with horizontal. If the reflected ray is totally polarized then refractive index of liquid will be

- (1) $\frac{4}{3}$
- (2) $\frac{3}{4}$
- (3) $\sqrt{2}$

(4) $\sqrt{3}$

26) A particle is projected from the surface of the earth (of radius R_e and mass M_e) with speed equal

to $\sqrt{\frac{GM_e}{R_e}}$, at certain angle from local horizontal as shown in the figure such that the angle subtended by arc between launching and landing site at earth's centre is $\beta = 60^\circ$. Calculate the maximum separation of the particle from the centre of the earth. Consider earth to be uniformly dense and air resistance to be absent.



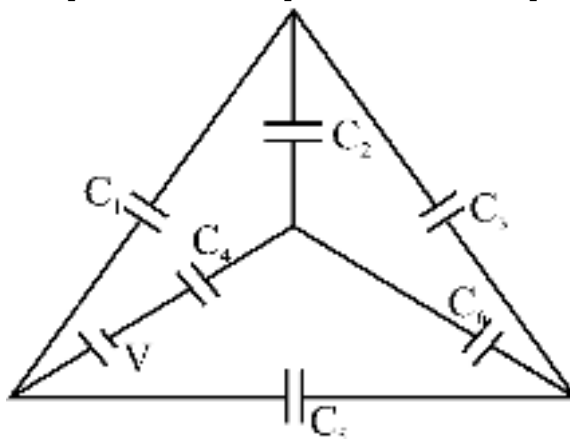
(1) $R_e \left(1 + \frac{\sqrt{3}}{2} \right)$

(2) $R_e (\sqrt{2} + 1)$

(3) $R_e \frac{(\sqrt{2} + 1)}{\sqrt{2}}$

(4) $R_e \frac{(\sqrt{2} + 1)}{(\sqrt{2} - 1)}$

27) Diagram shows 6 identical air capacitors connected to an ideal battery (V). In this condition, charge on capacitor C_6 is Q_1 . Now a dielectric whose dielectric constant is 2, is put between the plates of C_4 so that it occupies the entire space between the plates. Now charge on C_6 becomes Q_2 .



Then $\frac{Q_1}{Q_2}$ should be :-

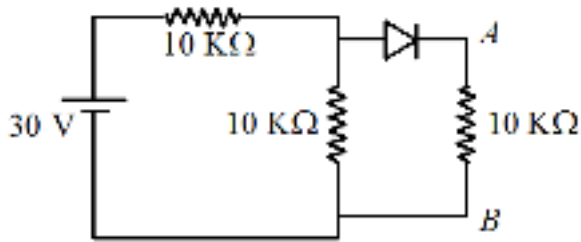
(1) $\frac{3}{4}$

(2) $\frac{1}{2}$

(3) $\frac{2}{1}$

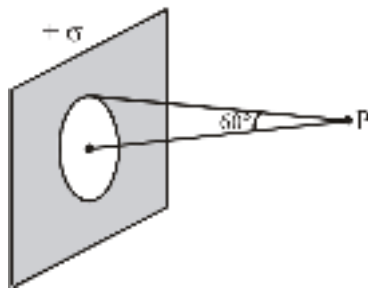
(4) $\frac{3}{2}$

28) In the given figure potential difference between A and B is :-



- (1) 0
- (2) 5 V
- (3) 10 V
- (4) 15 V

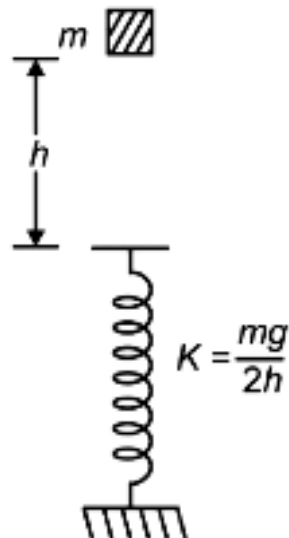
29) A disc is cut from infinite sheet of charge density σ as shown in figure then electric field at point



P is:-

- (1) $\frac{\sigma}{\epsilon_0}$
- (2) $\frac{\sigma}{2\epsilon_0}$
- (3) $\frac{\sigma}{4\epsilon_0}$
- (4) $\frac{\sigma}{8\epsilon_0}$

30) A block of mass 'm', falls from rest, from a height h, upon an ideal unstretched spring. The

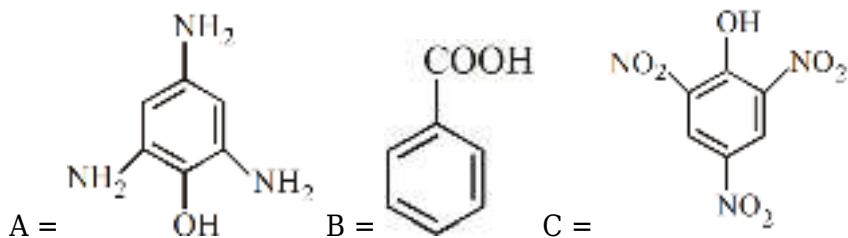


maximum compression in the spring, is

- (1) $h(\sqrt{2} - 1)$
- (2) $2h(\sqrt{2} + 1)$
- (3) $2h(\sqrt{2} - 1)$
- (4) $2h\sqrt{2}$

CHEMISTRY

1) Compound(s) which will liberate carbon dioxide with sodium bicarbonate solution is/are:

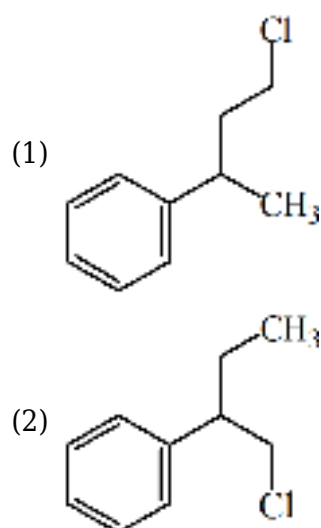


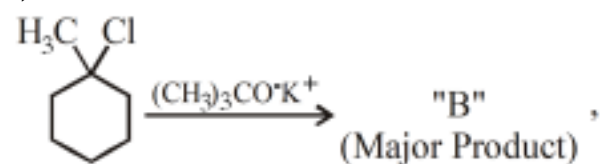
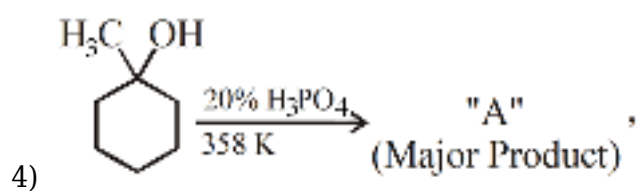
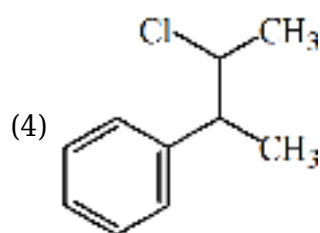
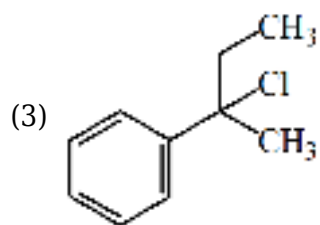
- (1) B only
- (2) C only
- (3) B and C only
- (4) A and B only

2) Staggered and eclipsed conformers of ethane are :

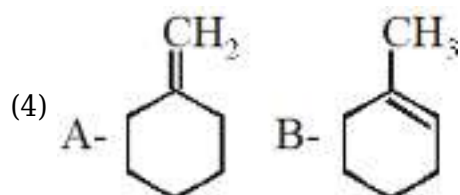
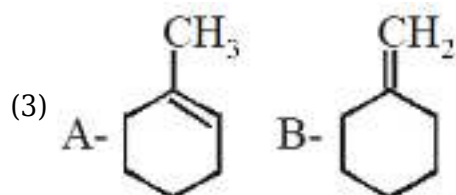
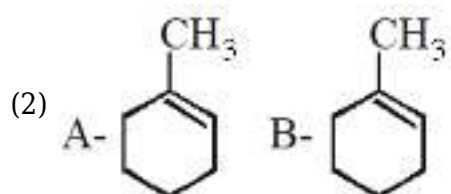
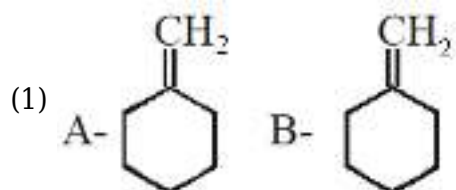
- (1) Polymers
- (2) Rotamers
- (3) Enantiomers
- (4) Mirror images

3) Reaction of Grignard reagent, C_2H_5MgBr with C_8H_8O followed by hydrolysis gives compound "A" which reacts instantly with Lucas reagent to give compound B, $C_{10}H_{13}Cl$. The Compound B is :





The product "A" and "B" formed in above reactions are :



5) What is the correct sequence of reagents used for converting nitrobenzene into m-



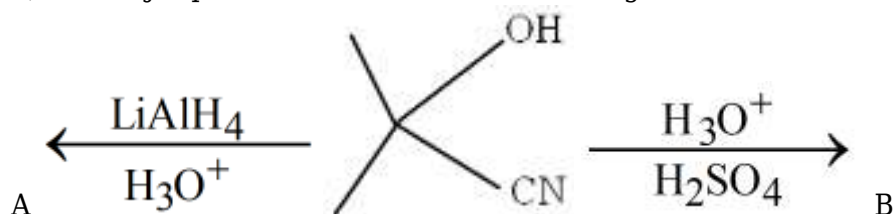
dibromobenzene ?

- (1) $\xrightarrow[\text{H}^+]{\text{NaNO}_2/\text{HCl}/\text{KBr}/}$
- (2) $\xrightarrow{\text{Br}_2/\text{Fe}} \xrightarrow{\text{Sn/HCl}} \xrightarrow{\text{NaNO}_2/\text{HCl}} \xrightarrow{\text{CuBr/HBr}}$
- (3) $\xrightarrow{\text{Sn/HCl}} \xrightarrow{\text{KBr}} \xrightarrow{\text{Br}_2} \xrightarrow{\text{H}^+}$
- (4) $\xrightarrow{\text{Sn/HCl}} \xrightarrow{\text{Br}_2} \xrightarrow{\text{NaNO}_2} \xrightarrow{\text{NaBr}}$

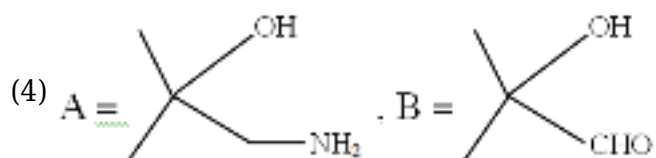
6) Which one of the following reactions will not form acetaldehyde?

- (1) $\xrightarrow[573\text{K}]{\text{Cu}} \text{CH}_3\text{CH}_2\text{OH}$
- (2) $\xrightarrow[\text{(ii) H}_2\text{O}]{\text{(i) DIBAL-H}} \text{CH}_3\text{CN}$
- (3) $\xrightarrow[\text{H}_2\text{O}]{\text{Pd(II)/Cu(II)}} \text{CH}_2 = \text{CH}_2 + \text{O}_2$
- (4) $\xrightarrow{\text{CrO}_3-\text{H}_2\text{SO}_4} \text{CH}_3\text{CH}_2\text{OH}$

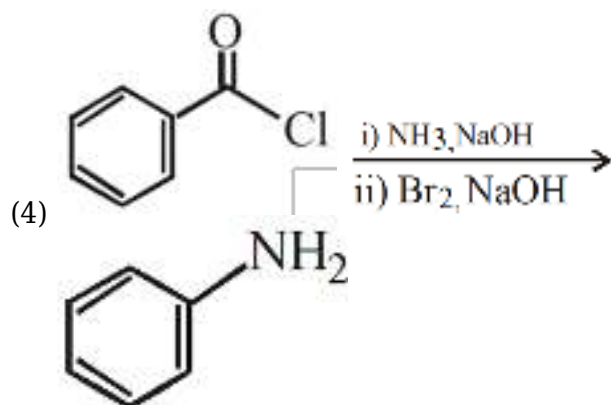
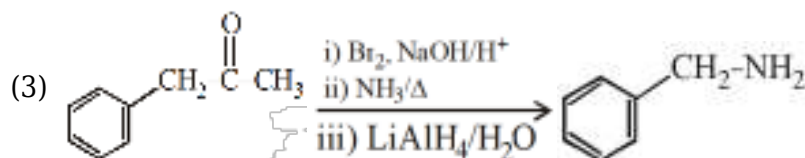
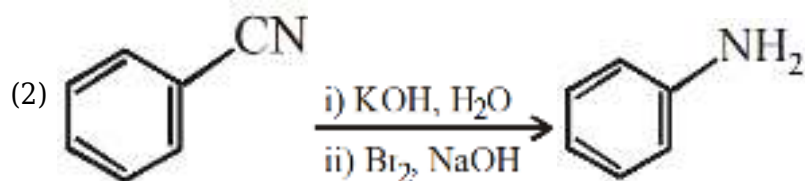
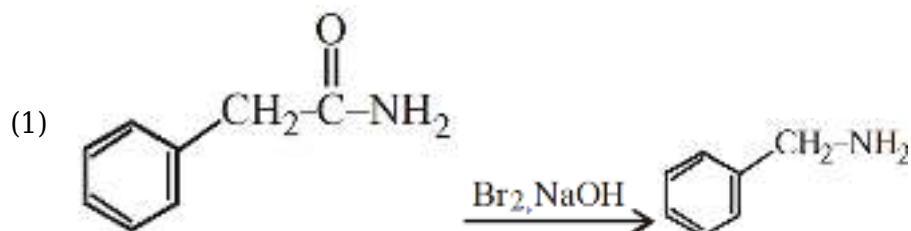
7) The major products A and B in the following set of reactions are :



- (1) $\text{A} = \text{tert-butyl-1,2-diol} \quad , \quad \text{B} = \text{tert-butyl-2-hydroxypropanal}$
- (2) $\text{A} = \text{tert-butyl-2-hydroxypropanal} \quad , \quad \text{B} = \text{tert-butyl-2-hydroxypropanoic acid}$
- (3) $\text{A} = \text{tert-butyl-2-aminoethanol} \quad , \quad \text{B} = \text{2-methyl-2-butenoic acid}$



8) Which of the following reaction DOES NOT involve Hoffmann Bromamide degradation ?



9) Match List-I with List-II

List-I		List-II	
(a)	Sucrose	(i)	β -D-Galactose and β -D-Glucose
(b)	Lactose	(ii)	α -D-Glucose and β -D-Fructose
(c)	Maltose	(iii)	α -D-Glucose and α -D-Glucose

Choose the correct answer from the options given below :

(1) (a) $\rightarrow$ (i), (b) $\rightarrow$ (iii), (c) $\rightarrow$ (ii)

(2) (a) $\rightarrow$ (iii), (b) $\rightarrow$ (i), (c) $\rightarrow$ (iii)

(3) (a) $\rightarrow$ (ii), (b) $\rightarrow$ (i), (c) $\rightarrow$ (iii)

(4) (a) $\rightarrow$ (iii), (b) $\rightarrow$ (ii), (c) $\rightarrow$ (i)

10) Orlon fibres are made up of :

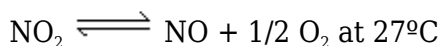
- (1) Polyacrylonitrile
- (2) Polyesters
- (3) Polyamide
- (4) Cellulose

11) The Difference in wavelength of first and last line of lyman series in emission spectrum of He^+ would be :

- (1) $\frac{1}{12R_H}$
- (2) $\frac{12}{R_H}$
- (3) $\frac{1}{4R_H}$
- (4) $\frac{1}{3R_H}$

12) For elementary gaseous phase reaction $2\text{NO} + \text{O}_2 \rightleftharpoons 2\text{NO}_2$ at 27°C Rate of the forward reaction is given by rate = $2 \times 10^3 [\text{NO}]^2[\text{O}_2]$ and Rate of reverse reaction at 27°C is given by rate = $20[\text{NO}_2]^2$

Hence equilibrium constant for reaction



- (1) 100
- (2) 0.01
- (3) 0.1
- (4) 10

13) The smallest repeating pattern which when repeated in three dimensions results in the crystal of the substance is called

- (1) Space lattice
- (2) Crystal lattice
- (3) Unit cell
- (4) coordination number

14) A solution containing components A and B follows Raoult's law:

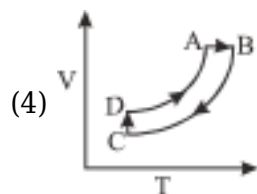
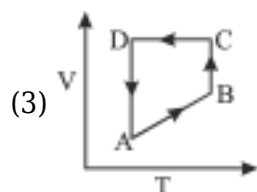
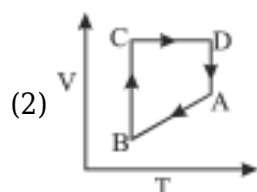
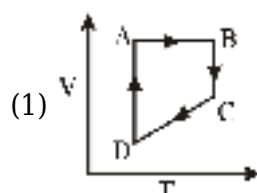
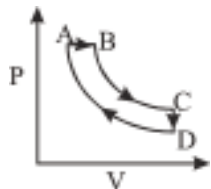
- (1) A - B attraction force is greater than A - A and B - B
- (2) A-B attraction force is less than A-A and B-B
- (3) A-B attraction force remains same as A - A and B-B
- (4) Volume of solution is different from sum of volume of solute and solvent

15) In a reaction, $\text{A} + \text{B} \rightarrow \text{product}$, rate is doubled when the concentration of B is doubled, and rate increases by a factor of 8 when the concentration of both the reactants (A and B) are doubled,

rate law for the reaction can be written as

- (1) $\text{rate} = k[A][B]^2$
- (2) $\text{rate} = k[A]^2[B]^2$
- (3) $\text{rate} = k[A][B]$
- (4) $\text{rate} = k[A]^2[B]$

16) A cyclic process ABCD is shown in PV diagram for an ideal gas. Which of the following diagram represents the same process ?



17) If $\text{C}_{(\text{s})} + \frac{1}{2} \text{O}_{2(\text{g})} \rightarrow \text{CO}_{(\text{g})}; \Delta H = -110 \text{ kJ}$
 $\text{C}_{(\text{s})} + \text{H}_2\text{O}_{(\text{g})} \rightarrow \text{CO}_{(\text{g})} + \text{H}_2; \Delta H = 132 \text{ kJ}$

The mole composition of mixture of O_2 & steam on being passed over coke at 1273 K, so that temperature remains constant is :

- (1) 0.6 : 1
- (2) 1.67 : 1
- (3) 0.3 : 1
- (4) 0.4 : 1

18) What volume of 0.2 M RNH_3Cl solution in ml should be added to 100 ml of 0.1 M RNH_2 solution to produce a buffer solution of $\text{pH} = 8.7$ at 25°C ?

Given pK_b of $RNH_2 = 5$; $\log 2 = 0.3$

- (1) 50 ml
- (2) 100 ml
- (3) 200 ml
- (4) None of these

19) The specific conductance of a N/10 KCl at 25°C is $0.0112 \text{ ohm}^{-1} \text{ cm}^{-1}$. The resistance of cell containing solution at the same temperature was found to be 55 ohms. The cell constant will be :

- (1) 6.16 cm^{-1}
- (2) 0.616 cm^{-1}
- (3) 0.0616 cm^{-1}
- (4) 616 cm^{-1}

20) Given below are a few electrolytes, indicate which one among them will bring about the coagulation of a gold sol. quickest and in the least of concentration?

- (1) NaCl
- (2) MgSO_4
- (3) $\text{Al}_2(\text{SO}_4)_3$
- (4) $\text{K}_4[\text{Fe}(\text{CN})_6]$

21)

Which one has highest 2nd I.E value?

- (1) Mn
- (2) Cr
- (3) V
- (4) Ti

22) What is the shape of the cationic part of solid Cl_2O_6 :

- (1) V-shape
- (2) Square pyramidal
- (3) Square planar
- (4) Tetrahedral

23) Consider the complex ions,

$\text{trans}[\text{Co}(\text{en})_2\text{Cl}_2]^+$ (A) and

$\text{cis}[\text{Co}(\text{en})_2\text{Cl}_2]^+$ (B). The correct statement regarding them is :

- (1) both (A) and (B) can be optically active
- (2) both (A) and (B) cannot be optically active
- (3) (A) can be optically active, but (B) cannot be optically active

(4) (A) cannot be optically active, but (B) can be optically active

24) The incorrect statement about tinstone ore is :-

- (1) It is also called cassiterite
- (2) It is separated by electromagnetic separation method from FeWO_4 impurities
- (3) It is an oxide ore
- (4) It contains Wolframite as a non-magnetic impurities

25) Which of the following order with respect to given properties is correct :

- (1) $\text{F}^- < \text{Cl}^- < \text{Br}^- < \text{I}^-$: Polarisability
- (2) $\text{Pb}^{+2} < \text{Pb}^{+4}$: Stability
- (3) $\text{BF}_3 > \text{BCl}_3$: Lewis acid character
- (4) $\text{Sn}^{+2} > \text{Sn}^{+4}$: Stability

26) Which of the following is insoluble and coloured salt ?

- (1) AgNO_2
- (2) Ag_3PO_4
- (3) CuBO_2
- (4) CH_3COOAg

27) Which of the following correct order for thermal stability of group IA metal carbonate?

- (1) $\text{Li}_2\text{CO}_3 < \text{Na}_2\text{CO}_3 < \text{K}_2\text{CO}_3 < \text{Rb}_2\text{CO}_3$
- (2) $\text{Rb}_2\text{CO}_3 < \text{K}_2\text{CO}_3 < \text{Na}_2\text{CO}_3 < \text{Li}_2\text{CO}_3$
- (3) $\text{Li}_2\text{CO}_3 < \text{Na}_2\text{CO}_3 < \text{Rb}_2\text{CO}_3 < \text{K}_2\text{CO}_3$
- (4) $\text{Rb}_2\text{CO}_3 < \text{K}_2\text{CO}_3 < \text{Li}_2\text{CO}_3 < \text{Na}_2\text{CO}_3$

28) When Cl_2 is passed over dry slaked lime at 40°C then

- (1) $\text{Ca}(\text{OCl})_2$ is obtained only
- (2) $\text{CaCl}_2 + \text{Ca}(\text{OH})_2$ is obtained only
- (3) $\text{Ca}(\text{OCl})_2 + \text{CaCl}_2 + \text{Ca}(\text{OH})_2 \cdot \text{H}_2\text{O}$ is obtained
- (4) CaO_2Cl is obtained

29) The electronic configuration of Einsteinium is : (Given atomic number of Einsteinium = 99)

- (1) $[\text{Rn}] 5f^{12} 6d^0 7s^2$
- (2) $[\text{Rn}] 5f^{11} 6d^0 7s^2$
- (3) $[\text{Rn}] 5f^{13} 6d^0 7s^2$
- (4) $[\text{Rn}] 5f^{10} 6d^0 7s^2$

30) Which of the following statement is correct for H_2O and D_2O ?

- (1) D₂O has higher number of valence shell electron than H₂O
- (2) D₂O has lower value of boiling point than H₂O
- (3) D₂O has higher number of neutrons than H₂O
- (4) H₂O has smaller number of protons than D₂O

ENGLISH PROFICIENCY

1) **Directions :** in each of the following questions, choose the most appropriate alternative to fill in the blanks.

I congratulate youyour success.

- (1) on
- (2) for
- (3) at
- (4) in

2) **Directions :** in each of the following questions, choose the most appropriate alternative to fill in the blanks.

Choose the correct question tag:

Let's go for a walk, ____?

- (1) shall we
- (2) will we
- (3) don't we
- (4) won't we

3) **Directions :** in each of the following questions, choose the most appropriate alternative to fill in the blanks.

Select the sentence that uses the **relative clause correctly**:

- (1) The laptop, what I bought last year, is already malfunctioning.
- (2) The student who project won the award received a scholarship.
- (3) The scientist whom we met yesterday explained the experiment clearly.
- (4) The book that written by my uncle is a bestseller.

4) **Select the option that best completes the analogy.**

OBSTINATE : YIELD ::

- (1) fragile : break
- (2) generous : donate
- (3) reluctant : accept
- (4) cautious : proceed

5) Select the correct meaning of the idiom:

"To turn a blind eye."

- (1) To refuse to compromise
- (2) To ignore something deliberately
- (3) To misunderstand unintentionally
- (4) To observe without interfering

6) Which word carries a **negative** connotation?

- (1) confident
- (2) stubborn
- (3) curious
- (4) assertive

7) *The old library stood like a weary guardian of forgotten wisdom, its shelves bending under the weight of stories long neglected. Sunlight filtered through dusty windows, casting sleepy patterns on the wooden floor. Visitors were few, yet the silence inside felt alive, as if the books themselves waited for someone to awaken their voices.*

In the passage, the simile “*stood like a weary guardian*” suggests that the library:

- (1) is physically collapsing
- (2) protects knowledge but appears old and tired
- (3) is guarded by an elderly person
- (4) is difficult to find because of its age

8) *The old library stood like a weary guardian of forgotten wisdom, its shelves bending under the weight of stories long neglected. Sunlight filtered through dusty windows, casting sleepy patterns on the wooden floor. Visitors were few, yet the silence inside felt alive, as if the books themselves waited for someone to awaken their voices.*

The phrase “*the silence inside felt alive*” is a metaphor implying that :

- (1) the library was overcrowded
- (2) people spoke very softly
- (3) the atmosphere seemed meaningful and expectant
- (4) the silence was frightening

9) *The old library stood like a weary guardian of forgotten wisdom, its shelves bending under the weight of stories long neglected. Sunlight filtered through dusty windows, casting sleepy patterns on the wooden floor. Visitors were few, yet the silence inside felt alive, as if the books themselves waited for someone to awaken their voices.*

Choose the option that best completes the sentence:

The shelves were ____ under the weight of books, a sign of years of accumulated knowledge.

- (1) drooping
- (2) bending
- (3) sliding
- (4) drifting

10) *The old library stood like a weary guardian of forgotten wisdom, its shelves bending under the weight of stories long neglected. Sunlight filtered through dusty windows, casting sleepy patterns on the wooden floor. Visitors were few, yet the silence inside felt alive, as if the books themselves waited for someone to awaken their voices.*

The visitors were few, yet the silence seemed _____, as though waiting to be disturbed.

- (1) dormant
- (2) fragile
- (3) oppressive
- (4) animated

LOGICAL REASONING

1) **Direction :** In each of the following questions, there are two words to the left of the sign :: which are connected in some way. The same relationship obtains between the third word and one of the four alternatives under it. Find the correct alternative in each question.

DRIVEN : EIDRVN :: BEGUM : ?

- (1) EUBGM
- (2) MGBEU
- (3) BGMEU
- (4) UEBGM

2) **Direction :** In each of the following questions, there are two words to the left of the sign :: which are connected in some way. The same relationship obtains between the third word and one of the four alternatives under it. Find the correct alternative in each question.

14 : 9 :: 26 : ?

- (1) 12
- (2) 13
- (3) 15
- (4) 31

3) **Direction :** In each of the following questions, four alternatives are given, out of which three are alike in a certain way while one is different. Choose the odd one.

- (1) BCD
- (2) NPR
- (3) KLM
- (4) PQR

4) **Direction :** In each of the following questions, four alternatives are given, out of which three are alike in a certain way while one is different. Choose the odd one.

- (1) CJG
- (2) HNK

- (3) ELI
- (4) JQN

5) Find the missing term in the following series.
 BC FG JK ___ RS VW

- (1) LM
- (2) OP
- (3) QR
- (4) NO

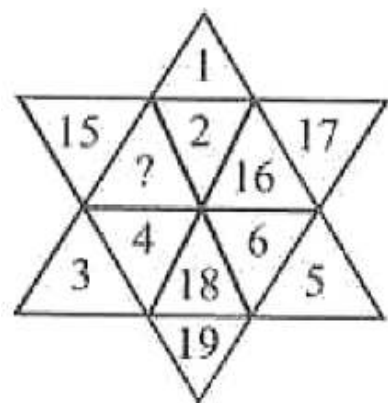
6) Which sequence of letters when placed at the blanks one after another will complete the given letter series ?
 aa - bb - aa - abbbb - a

- (1) bbaa
- (2) aabb
- (3) baba
- (4) abab

7) **Direction :** In the following question, one term in the number series is wrong. Find out the wrong term.
 6, 15, 35, 77, 165, 221

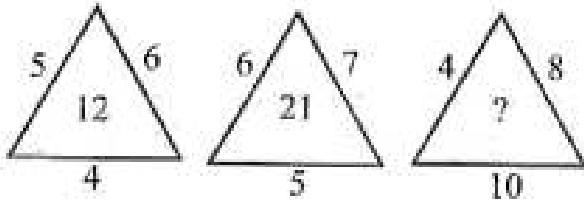
- (1) 35
- (2) 77
- (3) 165
- (4) 221

8) **Directions :** Find the missing character in each of the following questions.



- (1) 13
- (2) 14
- (3) 20
- (4) 21

9) **Directions :** Find the missing character in each of the following questions.



- (1) 14
- (2) 22
- (3) 32
- (4) 37

10) **Direction :** In each of the following questions, a part of the figure is missing. Find out from the



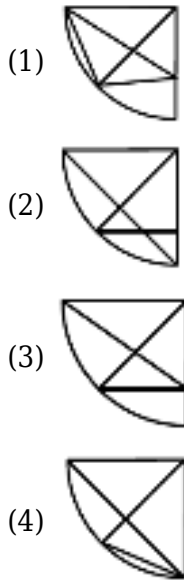
given options (1, 2, 3 and 4) the right figure to fit in the missing place.

- (1)
- (2)
- (3)
- (4)

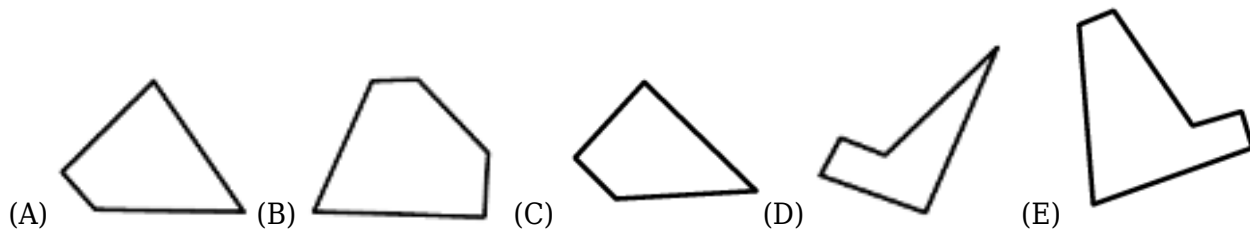
11) **Direction :** In each of the following questions, a part of the figure is missing. Find out from the



given options (1, 2, 3 and 4) the right figure to fit in the missing place.

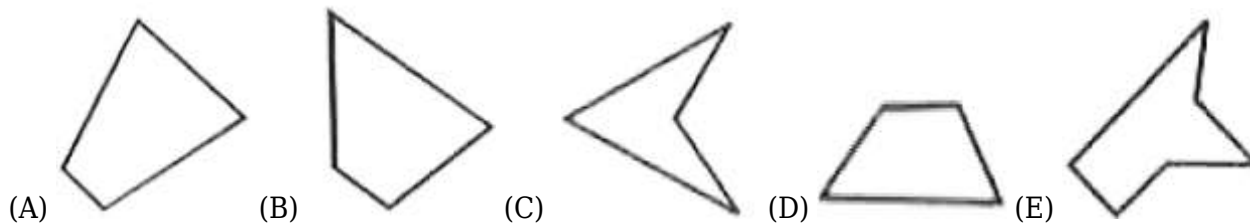


12) **Direction :** In each of the following questions select that combination of parts (A), (B), (C), (D) and (E) which if fitted together will form an equilateral triangle.



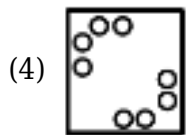
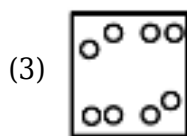
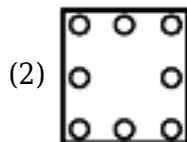
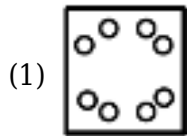
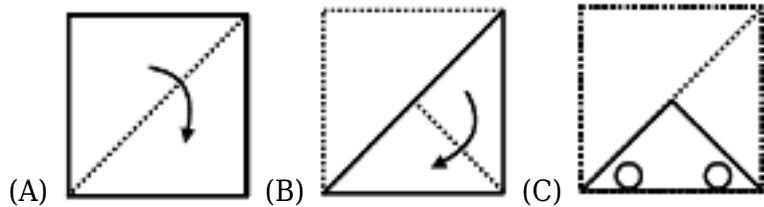
- (1) ABD
- (2) BCD
- (3) BDE
- (4) ADE

13) **Direction :** In each of the following questions select that combination of parts (A), (B), (C), (D) and (E) which if fitted together will form an equilateral triangle.

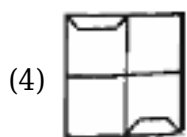
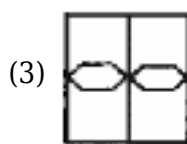
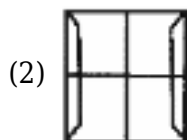
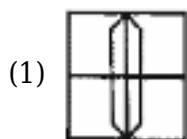
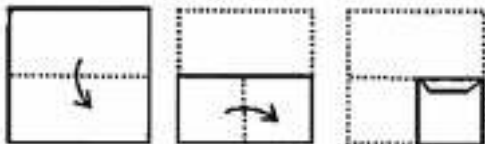


- (1) ABC
- (2) BCE
- (3) BDE
- (4) ADE

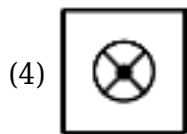
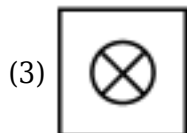
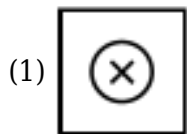
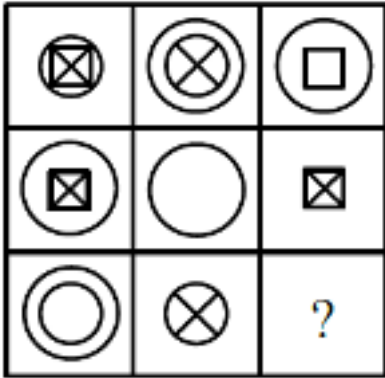
14) **Direction :** In each of the following questions a set of three figures A, B and C showing a sequence of folding of a piece of paper. Fig. (C) shows the manner in which the folded paper has been cut. These three figures are followed by four answer figures from which you have to choose a figure which would most closely resemble the unfolded form of fig, (C).



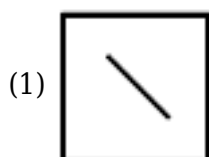
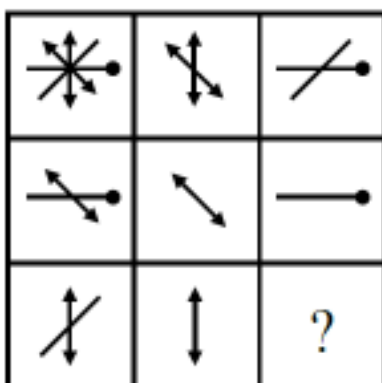
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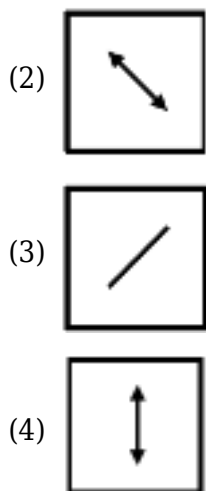


16) **Direction :** In each of the following questions, select the answer figure that will fit in the blank space in the question figure, maintaining the pattern in the proper sequence.



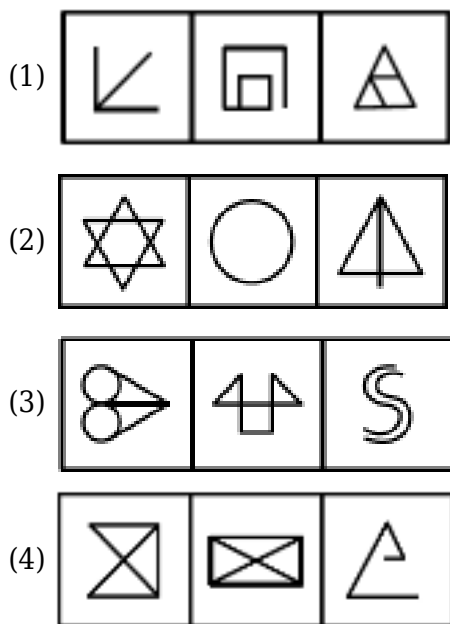
17) **Direction :** In each of the following questions, select the answer figure that will fit in the blank space in the question figure, maintaining the pattern in the proper sequence.



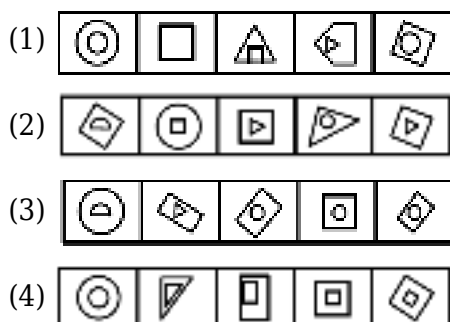


18) **Direction :** Each of the following questions contains four rows of figures. As four alternatives. Each row contains four of five different designs. You have to study carefully each row and judge which series of figures follows the stated rule exactly.

Rule : Any figure can be traced by a single unbroken line without retracing.



19) In each of the following rows, five figures are given. One of the four rows contains design that follow a certain pattern which is not followed in figures of other rows. Choose the row containing these figures.



20) **Direction :** Read the following information and then answer the questions given below it. The

selection committee of a company laid down the following criteria of selection for the post of Manager-Account.

- (A) The candidate must be a Post-graduate in Commerce.
- (B) The candidate must have completed 21 years and should be not more than 35 years as on 31st July 1996.
- (C) If the candidate does not satisfy the criteria A above but has completed his CA examination, he will be referred to Director Finance, who can allow the candidate to appear in the interview if otherwise eligible.
- (D) If the candidate fulfils all the criteria mentioned in A and B above, he/she will be called for group discussion.
- (E) The candidate must get 50% marks to qualify in the group discussion.
- (F) If the candidate qualifies in the group discussion, he/she will be called for the interview.
- (G) The candidate must get 30% marks in the interview (out of 50) to get finally selected.

Based on the above criteria, decide which of the following courses of action should be taken in the case of candidates described in each of the following questions.

Mark your answer as :

Mr. Patel, a Post-graduate in Commerce obtained 70% in group discussion and secured 20% marks in interview. He was 35 years as on 31st July, 1996.

- (1) if the candidate can be selected
- (2) if the candidate is to be referred to Director-Finance
- (3) if the candidate can be called for interview
- (4) if the candidate cannot be selected

MATHEMATICS

1) If roots of the equation $x^2 + px + q = 0$ are $\tan 22^\circ$ and $\tan 23^\circ$, then value of $(p - q)$ is

- (1) 1
- (2) 2
- (3) -1
- (4) -2

2) The number of solution(s) of the equation $|x - 3| \frac{(x^2 - 8x + 15)}{(x - 2)} = 1$ is

- (1) 0
- (2) 2
- (3) 1
- (4) 3

3) If α and β are the distinct roots of the equation $x^2 + (2)^{1/4}x + 2^{1/2} = 0$, then the value of $\alpha^{96}(\beta^{12} - 1) + \beta^{96}(\alpha^{12} - 1)$ is equal to

- (1) 7×2^{24}
- (2) 11×2^{24}
- (3) 7×2^{25}

(4) 11×2^{25}

4) If Z be a complex number satisfying $Z^4 + Z^3 + 2Z^2 + Z + 1 = 0$, then set of all possible value of $|Z|$ is

(1) $\{1, 2\}$

(2) $\{1\}$

(3) $\{1, 2, 3\}$

(4) $\{4\}$

5) If $|z_1| = 1$, $|z_2| = 2$, $|z_3| = 3$, then $|z_1 + z_2 + z_3|^2 + |-z_1 + z_2 + z_3|^2 + |z_1 - z_2 + z_3|^2 + |z_1 + z_2 - z_3|^2$ is equal to _____,

(1) 56

(2) 58

(3) 54

(4) 52

6) If ${}^{15}C_{3r} : {}^{15}C_{r+1} = 11 : 3$, then the value of 'r' is

(1) 1

(2) 2

(3) 3

(4) 4

7) The number of ways in which a committee of 6 members can be formed from 8 gentlemen and 4 ladies so that the committee contains atleast 3 ladies is :-

(1) 252

(2) 672

(3) 444

(4) 420

8) There are $5n$ terms in an A.P. If S_n denotes the sum of first n terms and $S_{3n} - S_{2n} = S$, then sum of all the $5n$ terms is -

(1) $10S$

(2) $5S$

(3) $15S$

(4) S

9) If 100^{th} , 200^{th} and 400^{th} term of an arithmetic progression are in geometric progression, then common ratio of geometric progression is

(1) $\frac{1}{2}$

(2) 2

(3) $\frac{3}{2}$

(4) 4

10) The sum to 50 terms of the series $1 + 2\left(1 + \frac{1}{50}\right) + 3\left(1 + \frac{1}{50}\right)^2 + \dots$ is given by

(1) 2500

(2) 2550

(3) 2450

(4) None of these

11) The sum of series $\tan^{-1}\left(\frac{\sqrt{3}}{9}\right) + \tan^{-1}\left(\frac{\sqrt{3}}{19}\right) + \tan^{-1}\left(\frac{\sqrt{3}}{33}\right) + \tan^{-1}\left(\frac{\sqrt{3}}{51}\right) + \dots$ up to infinite terms is equal to

(1) $\frac{\pi}{6}$

(2) $\frac{\pi}{3}$

(3) $\frac{\pi}{4}$

(4) $\frac{2\pi}{3}$

12) In the expansion of $\left(x + \sqrt{x^2 - 1}\right)^6 + \left(x - \sqrt{x^2 - 1}\right)^6$, the number of terms is

(1) 7

(2) 14

(3) 6

(4) 4

13) If $\tan A \tan(60^\circ - 3A) \tan(60^\circ + A) \tan(60^\circ + 3A) = 1$, then the number of values of A such that $0 < A < 45^\circ$, satisfying the above equation is -

(1) 1

(2) 2

(3) 3

(4) 0

14) The number of integral values of k, for which the x-coordinate of the point of intersection of the lines $3x + 4y = 9$ and $y = kx + 1$ is also an integer, is

(1) 2

(2) 0

(3) 4

(4) 1

15)

A pair of perpendicular straight lines drawn through the origin form an isoscles triangle with line $2x + 3y = 6$, then area of the triangle so formed is

(1) $\frac{36}{13}$

(2) $\frac{12}{17}$

(3) $\frac{13}{5}$

(4) $\frac{17}{13}$

16) The locus of the mid point of the chord of circle $x^2 + y^2 - 2x - 2y - 2 = 0$ which subtends an angle of 120° at the centre, is

(1) $x^2 + y^2 - 2x - 2y + 1 = 0$

(2) $x^2 + y^2 + x + y + 1 = 0$

(3) $x^2 + y^2 - 2x - 2y - 1 = 0$

(4) $x^2 + y^2 = 1$

17) The area (in sq. units) of the quadrilateral formed by the tangents at the end points of the latera recta of the ellipse $\frac{x^2}{16} + \frac{y^2}{7} = 1$ is :

(1) $\frac{132}{3}$

(2) $\frac{128}{3}$

(3) $\frac{64}{3}$

(4) $\frac{8}{3}$

18) If the line $y = 3x + \lambda$ touches the hyperbola $9x^2 - 5y^2 = 45$, then a value of λ is:

(1) 36

(2) 45

(3) 6

(4) 15

19) $\lim_{x \rightarrow \frac{\pi}{4}} \frac{8\sqrt{2} - (\cos x + \sin x)^7}{\sqrt{2} - \sqrt{2} \sin 2x}$ is equal to

- (1) 14
- (2) 7
- (3) $14\sqrt{2}$
- (4) $7\sqrt{2}$

20) If $p \Rightarrow (q \vee r)$ is false then the truth values of p, q, r are respectively

- (1) F,T,T
- (2) T,F,F
- (3) T,T,F
- (4) F,F,F

21) Let the observations x_i ($1 \leq i \leq 10$) satisfy the equations, $\sum_{i=1}^{10} (x_i - 5) = 10$ and $\sum_{i=1}^{10} (x_i - 5)^2 = 40$ if μ and λ are the mean and the variance of the observations, $x_1 - 3, x_2 - 3, \dots, x_{10} - 3$ respectively, then the ordered pair (μ, λ) is equal to

- (1) (6, 6)
- (2) (3, 6)
- (3) (6, 3)
- (4) (3, 3)

22) A survey shows that 73% of the persons working in an office like coffee, where 65% like tea. If x denotes the percentage of them, who like both coffee and tea, then x cannot be :

- (1) 63
- (2) 36
- (3) 54
- (4) 38

23) For $x, y \in \mathbf{R}$, define a relation R by xRy if and only if $x - y + \sqrt{2}$ is an irrational numbers. Then R is

- (1) An equivalence relation
- (2) Symmetric
- (3) Transitive
- (4) Reflexive but not symmetric & transitive

24) If $A = \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$, $P = \begin{pmatrix} \cos \theta & \sin \theta \\ -\sin \theta & \cos \theta \end{pmatrix}$, $Q = P^T A P$, find $PQ^{2014}P^T$:

- (1) $\begin{pmatrix} 1 & 2^{2014} \\ 0 & 1 \end{pmatrix}$

$$(2) \begin{pmatrix} 1 & 4028 \\ 0 & 1 \end{pmatrix}$$

$$(3) \left(P^T \right)^{2013} A^{2014} P^{2013}$$

$$(4) P^T A^{2014} P$$

25) If A & B are symmetric & C is a skew symmetric matrix, then ABC - CBA is always-

- (1) symmetric matrix
- (2) skew symmetric matrix
- (3) orthogonal matrix
- (4) null matrix

26) If A is matrix of order (3×3) and $|A| = 2$ then value of $|\text{adj adj adj adj adj } (2A)|$ is equal to : -

- (1) 2^9
- (2) 2^{128}
- (3) 2^{32}
- (4) None

27) The system of equations

$$ax + y + z = a - 1,$$

$$x + ay + z = a - 1, x + y + az = a - 1 \text{ has no solution, if } a \text{ is}$$

- (1) -2 or 1
- (2) -2
- (3) 1
- (4) -1

28) Range of the function $f(x) = \log_2 \left(\frac{\sin x - \cos x + 3\sqrt{2}}{\sqrt{2}} \right)$ is:

- (1) (1, 2)
- (2) R
- (3) [-1, 2]
- (4) [1, 2]

29) Let $f(x) = \frac{\alpha x}{x+1}$, $x \neq -1$. Then for what value of α is $f(f(x)) = x$?

- (1) $\sqrt{2}$
- (2) $-\sqrt{2}$
- (3) 1
- (4) -1

30) In the interval $\left(-\frac{\pi}{3}, \frac{\pi}{3}\right)$; the function $f(x) = \frac{-x}{2} + \sin x$ is :

- (1) increasing
- (2) decreasing
- (3) constant
- (4) neither increasing nor decreasing

31) If $y = \sin^{-1} \left(\frac{1-x^2}{1+x^2} \right)$, then $\frac{dy}{dx}$ equals

- (1) $\frac{2}{1-x^2}$
- (2) $\frac{1}{1+x^2}$
- (3) $\pm \frac{2}{1+x^2}$
- (4) $-\frac{2}{1+x^2}$

32) The ratio between the height of a right circular cone of maximum volume inscribed in a sphere and the diameter of the sphere is -

- (1) 2 : 3
- (2) 3 : 4
- (3) 1 : 3
- (4) 1 : 4

33) Solution of differential equation $\sin y \frac{dy}{dx} + \frac{1}{x} \cos y = x^4 \cos^2 y$ is
(Where C is the constant of integration)

- (1) $x \sec y = x^6 + C$
- (2) $6x \sec y = x + C$
- (3) $6x \sec y = x^6 + C$
- (4) $6x \sec y = 6x^6 + C$

34) $\int \frac{2e^{2x} + e^x}{3e^{2x} - 2e^x - 1} dx$ is equal to -
(where C is constant of integration)

- (1) $\frac{1}{4} \ln \left| \frac{(e^x - 1)^{1/3}}{(3e^x + 1)^3} \right| + C$
- (2) $\frac{1}{4} \ln \left| \frac{(e^x - 1)^3}{(3e^x + 1)^{1/3}} \right| + C$

$$(3) \frac{1}{3} \ln \left| \frac{(e^x - 1)^4}{(3e^x + 1)^{1/4}} \right| + C$$

$$(4) \frac{1}{3} \ln \left| \frac{(e^x - 1)^{1/4}}{(3e^x + 1)^4} \right| + C$$

35) The value of $\int_0^{\sin^2 x} \sin^{-1} \sqrt{t} dt + \int_0^{\cos^2 x} \cos^{-1} \sqrt{t} dt$ is, where $x \in \left(0, \frac{\pi}{2}\right)$

- (1) $\pi/2$
- (2) 1
- (3) $\pi/4$
- (4) None of these

36) Let R be the region satisfying $y < x^2 + 1$, $y > x - 1$, $x < 1$ and $x > 0$, then area of R is

- (1) $\frac{11}{6}$
- (2) $\frac{3}{2}$
- (3) $\frac{5}{6}$
- (4) 2

37)

Consider three vectors $\vec{a}$, $\vec{b}$, $\vec{c}$ such that $|\vec{a}| = 2$, $|\vec{b}| = 1$, $|\vec{c}| = 4$. Angle between $\vec{a}$ and $\vec{b}$ is 120° and $\vec{c}$ lies along the bisector of $\vec{a}$ and $\vec{b}$. Which of the following is true ?

- (1) $2\vec{a} - \vec{c} + 4\vec{b} = 0$
- (2) $\vec{a} - 3\vec{c} - 4\vec{b} = 0$
- (3) $3\vec{a} - \vec{c} - 4\vec{b} = 0$
- (4) $\vec{a} + \vec{b} + \vec{c} = 0$

38) $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = 4\hat{i} + 3\hat{j} + 4\hat{k}$, $\vec{c} = \hat{i} + \alpha\hat{j} + \beta\hat{k}$ are linearly dependent vectors and $|\vec{c}| = \sqrt{3}$ then

- (1) $\alpha = 1, \beta = -1$
- (2) $\alpha = 1, \beta = 0$
- (3) $\alpha = -1, \beta = -1$
- (4) $\alpha = \pm 1, \beta = 1$

39) If for some $a \in \mathbb{R}$, the lines $L_1 : \frac{x+1}{2} = \frac{y-2}{-1} = \frac{z-1}{1}$ and $L_2 : \frac{x+2}{\alpha} = \frac{y+1}{5-\alpha} = \frac{z+1}{1}$ are coplanar,

then the line L_2 passes through the point :

- (1) $(-2, 10, 2)$
- (2) $(10, 2, 2)$
- (3) $(10, -2, -2)$
- (4) $(2, -10, -2)$

40) The coefficients a , b and c of the quadratic equation, $ax^2 + bx + c = 0$ are obtained by throwing a dice three times. The probability that this equation has equal roots is:

- (1) $\frac{1}{72}$
- (2) $\frac{5}{216}$
- (3) $\frac{1}{36}$
- (4) $\frac{1}{54}$

ANSWER KEYS

PHYSICS

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A.	2	4	4	1	3	2	3	3	2	3	4	1	2	1	4	4	3	2	4	4
Q.	21	22	23	24	25	26	27	28	29	30										
A.	2	4	2	3	1	1	1	3	3	2										

CHEMISTRY

Q.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A.	3	2	3	3	2	4	3	3	3	1	1	3	3	3	4	3	1	2	2	3
Q.	51	52	53	54	55	56	57	58	59	60										
A.	2	1	4	4	1	2	1	3	2	3										

ENGLISH PROFICIENCY

Q.	61	62	63	64	65	66	67	68	69	70
A.	1	1	3	3	2	2	2	3	2	4

LOGICAL REASONING

Q.	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
A.	2	3	2	2	4	1	4	2	3	4	3	2	3	1	3	1	3	2	4	1

MATHEMATICS

Q.	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110
A.	3	2	3	2	1	3	1	2	2	1	1	4	3	1	1	1	2	3	1	2
Q.	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130
A.	4	2	4	2	1	2	2	4	4	1	3	1	3	2	3	1	1	4	4	2

SOLUTIONS

PHYSICS

1) **Question Explanation:** Find the dimensional formula for Young's modulus (Y) when Velocity (V), Acceleration (A), and Force (F) are fundamental quantities.

Concept: This question is based on method of dimensions.

Solution:

Dimensions of speed are $[V] = [LT^{-1}]$

Dimensions of acceleration are $[A] = [LT^{-2}]$

Dimensions of force are, $[F] = [MLT^{-2}]$

Dimension of Young modulus is $[Y] = [MLT^{-2}]$

Let dimensions of Young's modulus is expressed in terms of speed, acceleration and force as;

$$[Y] = [V]^\alpha [A]^\beta [F]^\gamma$$

Then substituting dimensions in terms of M,L and T we get,

$$[ML^{-1}T^{-2}] = [LT^{-1}]^\alpha [LT^{-2}]^\beta [MLT^{-2}]^\gamma$$

$$= [M^\gamma L^{\alpha+\beta+\gamma} T^{-\alpha-2\beta-2\gamma}]$$

Now comparing powers of basic quantities on both sides we get,

$$\gamma = 1$$

$$\alpha + \beta + \gamma = -1$$

$$\text{and } -\alpha - 2\beta - 2\gamma = -2$$

Solving these we get;

$$\alpha = -4, \beta = 2, \gamma = 1$$

Substituting α, β & γ in (i) we get;

$$[Y] = [V^{-4} A^2 F^1]$$

Final Answer The correct option is (2)

2)

required vector = $A \cos \theta \hat{A}$

$$= \frac{\vec{A} \cdot \vec{B}}{|\vec{B}| |\vec{A}|} \vec{A} \quad (\theta = \text{angle b/w A \& B})$$

$$= \frac{(2 - 2 + 6)}{3} \frac{(\hat{i} + 2\hat{j} + 3\hat{k})}{\sqrt{14}}$$

$$= \frac{2}{\sqrt{14}} (\hat{i} + 2\hat{j} + 3\hat{k})$$

4)

Maximum current through capacitor = $i = \frac{V_0}{Z}$

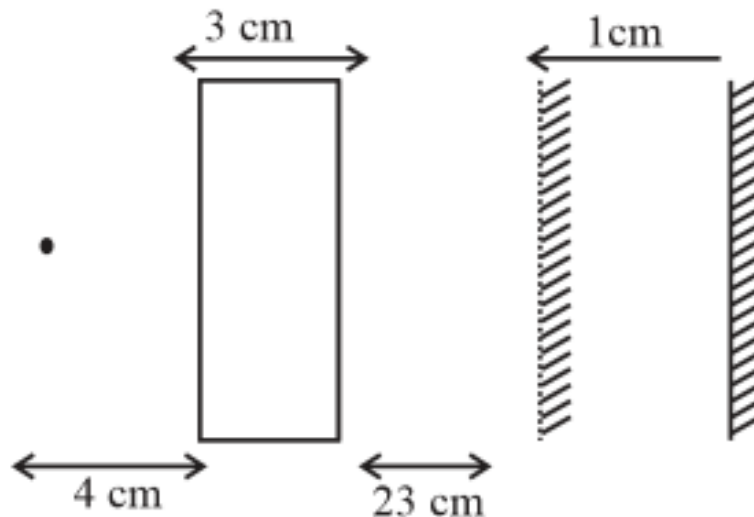
$$i = \frac{V_0}{Z}$$

$$Q\omega = \frac{V_0}{Z}$$

$$Q = \frac{V_0}{\omega Z}$$

5) **Question Explanation:** Finding the final image position.

Concept: Image formation by slab and mirror.



Shifting the mirror by slab,

$$\Delta x = \left(1 - \frac{1}{\mu}\right) t = \left(1 - \frac{1}{3/2}\right) 3$$

$$= \frac{1}{3} \times 3 = 1 \text{ cm}$$

virtual mirror is at distance 30 cm from object

so image is formed at 30 cm from virtual mirror.

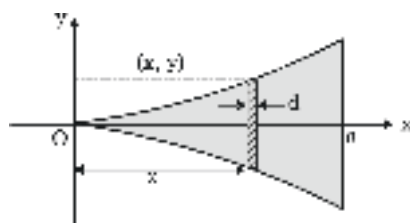
so from actual mirror, image is at 29 cm.

Final Answer: Option (3)

7) Theoretical

$$8) T_1 \propto (\ell_1 - \ell) \& T_2 \propto (\ell_2 - \ell)$$

$$\therefore \frac{\ell_1 - \ell}{\ell_2 - \ell} = \frac{T_1}{T_2} \Rightarrow T_2 \ell - T_1 \ell = T_2 \ell_1 - T_1 \ell_2 \Rightarrow \ell = \frac{T_2 \ell_1 - T_1 \ell_2}{T_2 - T_1}$$



9)

$$\begin{aligned}
 dl &= \frac{1}{12} dm \times (2y)^2 \\
 dl &= \frac{1}{12} (2y)^3 dx_\rho \\
 I &= \frac{1}{12} \times 8\rho \times \int_0^{6a} x^3 dx \\
 \Rightarrow I &= \frac{2}{3} \times \frac{a^4 \rho}{4} = \frac{2a^4 \rho}{12}, N = 2
 \end{aligned}$$

10) From Bohr model $\frac{1}{\lambda} = R \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$

$$\frac{1}{\lambda_1} = R \left(\frac{1}{2^2} - \frac{1}{3^2} \right) = \frac{5}{36} R \quad \dots (i)$$

and $\frac{1}{\lambda_2} = R \left(\frac{1}{1^2} - \frac{1}{2^2} \right) = \frac{3}{4} R \quad \dots (ii)$

$$\frac{\lambda_1}{\lambda_2} = \frac{27}{5}$$

Dividing eq. (i) and (ii), we get

11) $k(T - 30) = k_1(30 - (-10))$
 $k(T - 30) = k_1(40) \quad \dots (1)$
 $k(T - 15) = k_1(15 - (-30))$
 $k(T - 15) = k_1(45) \quad \dots (2)$
 solving (1) & (2)
 $T = 150^\circ \text{C}$

13) $\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2mE}}, mv = \sqrt{2mE}$

$$\lambda \propto \frac{1}{\sqrt{E}}$$

$$\frac{\lambda_2}{\lambda_1} = \sqrt{\frac{E_1}{E_2}} = \frac{3}{4}, \lambda_2 = 0.75 \lambda_1$$

$$\frac{E_1}{E_2} = \left(\frac{3}{4} \right)^2$$

$$E_2 = \frac{16}{9} E_1 = \frac{16}{9} E \quad (E_1 = E)$$

Extra energy given = $\frac{16}{9} E - E = \frac{7}{9} E$

Ans. 2

15) Question Explanation:

Two masses, $m_1 = 2 \text{ kg}$ and $m_2 = 4 \text{ kg}$, are placed on a smooth horizontal surface. The spring is compressed by $d = 5 \text{ cm}$ and released. We need to identify the INCORRECT statement.

Concept:

The potential energy stored in the compressed spring transforms into the kinetic energy of both blocks at the mean position.

Solution:

Velocity at Mean Position ($v_{\max}$):

Combined mass $M = m_1 + m_2 = 2 + 4 = 6 \text{ kg}$.

Angular frequency $\omega = \sqrt{\frac{k}{M}} = \sqrt{\frac{600}{6}} = 10 \text{ rad/s}$.

$v_{\max} = \omega \times d = 10 \text{ rad/s} \times 0.05 \text{ m} = 0.5 \text{ m/s}$.

At the mean position, both blocks have this same velocity, so their relative speed is 0, not 1 m/s. (Statement 1 is INCORRECT).

New Amplitude for m_1 (A'):

After separation, m_1 oscillates alone with $v_{\max} = 0.5 \text{ m/s}$ at its new mean position.

Using energy conservation for m_1 :

$$\frac{1}{2}m_1 v_{\max}^2 = \frac{1}{2}k(A')^2$$

$$2 \times (0.5)^2 = 600 \times (A')^2 \Rightarrow 0.5 = 600(A')^2$$

$$(A')^2 = \frac{0.5}{600} = \frac{1}{1200} \Rightarrow A' = \frac{1}{20\sqrt{3}} \text{ m}$$

$$A' = \frac{100}{20\sqrt{3}} \text{ cm} = \frac{5}{\sqrt{3}} \text{ cm} \text{ . (Statement 2 is correct; Statement 3 is INCORRECT).}$$

Maximum Kinetic Energy of m_1 :

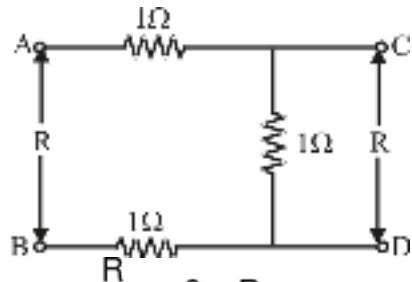
$$K_{\max} = \frac{1}{2}m_1 v_{\max}^2 = \frac{1}{2} \times 2 \times (0.5)^2 = 0.25 \text{ J}$$

(Statement 4 is correct).

Final answer:

Option (4)

17) Let equivalent resistance between A and B be R_1 then equivalent resistance between C and D will also be R .



$$R' = \frac{R}{R+1} + 2 = R \text{ or } R^2 - 2R - 2 = 0$$

$$\square R = \frac{2 \pm \sqrt{4+8}}{2} = \sqrt{3} + 1$$

18) Question Explanation:

The problem asks to find the maximum height reached by a mass $2m$ on a smooth circular track of mass m . The track is initially given horizontal velocity of $\sqrt{2gR}$ towards the left and released.

Concept:

This question is based on conservation of momentum, conservation of energy.

Solution: Let v be the final speed of system.

By conserving momentum

$$m(\sqrt{2gR}) = (m + 2m)v \quad \dots\dots(1)$$

By W.E.T.

$$-2mgh = \frac{3}{2}mv^2 - \frac{1}{2}m(2gR) \quad \dots\dots(2)$$

On solving we get

$$h = \frac{R}{3}$$

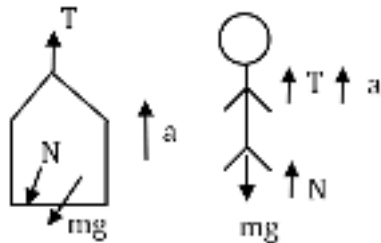
Final answer:

The correct option is (2).

21) **Explanation Question:** We have to find the acceleration of the painter when normal contact force between painter and lift is given

Concept : Newton's IInd law of motion

Solution: For system



$$\text{for lift } T - N - 250 = 25a \quad \dots(1)$$

$$\text{for painter } T + N - 1000 = 100a \quad \dots\dots(ii)$$

$$N = 450 \Rightarrow T = 25a + 700$$

$$25a + 700 + 450 - 1000 = 100a$$

$$\Rightarrow 75a = 150$$

$$a = 2\text{m/s}^2$$

Acceleration of painter is 2m/s^2

Final answer: option (2)

23) **Question Explanation :** We need to determine the velocity-time graphs (v_1 for Block A and v_2 for Plank B). Block A slides on Plank B with friction, while Plank B slides on a smooth floor.

Concept: Kinetic friction is a constant force, which creates constant acceleration. This means the velocity-time graph must be a straight line (linear) for both bodies.

Solution:

Step 1: Analyze Block A Block A starts with velocity v_0 . Friction acts opposite to its motion.

This causes constant deceleration. Therefore, v_1 decreases linearly (straight line with negative slope).

Step 2: Analyze Plank B Plank B starts from rest. Friction acts in the direction of motion (pulling it forward). This causes constant acceleration. Therefore, v_2 increases linearly (straight line with positive slope).

Step 3: Common Velocity When the velocities become equal ($v_1 = v_2$), relative slipping stops. Friction vanishes. Since the ground is smooth, there is no external force to stop them. They continue moving together at a constant velocity. Graph 2 correctly shows linear changes meeting at a constant horizontal line.

Final Answer: Option (2)

24)

Question Explanation: The question asks to identify the correct statement regarding internal energy changes for a monoatomic gas in a cyclic process.

Concept: First Law of Thermodynamics and Internal Energy.

Solution:

Process CA : $\Delta U_{CA} = 1 \times C_v \times (T_A - T_C) = \frac{3}{2}R \times (300 - 450) = \frac{3}{2}R \times (-150) = -225R$ (Option 1 is incorrect).

Process AB:

$\Delta U_{AB} = 1 \times C_v \times (T_B - T_A) = \frac{3}{2}R \times (600 - 300) = \frac{3}{2}R \times (300) = 450R$. (Option 2 is incorrect)

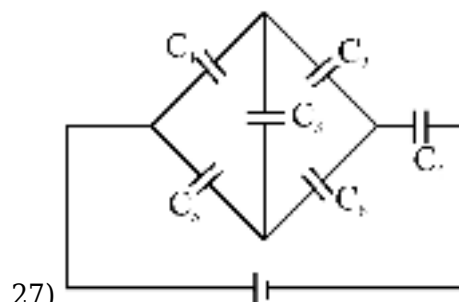
Process BC: $\Delta U_{BC} = 1 \times C_v \times (T_C - T_B) = \frac{3}{2}R \times (450 - 600) = \frac{3}{2}R \times (-150) = -225R$ (Option 3 is correct).

Whole Cycle: $\Delta U_{\text{cycle}} = \Delta U_{AB} + \Delta U_{BC} + \Delta U_{CA} = 450R - 225R - 225R = 0$. (Option 4 is incorrect).

Final Answer: Option (3)

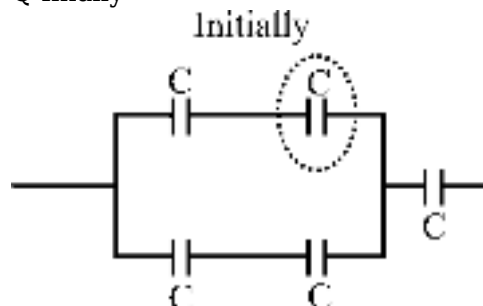
25) Brewster's angle = 53°

$$\tan 53^\circ = \frac{n_d}{n_r} = \frac{4}{3}$$

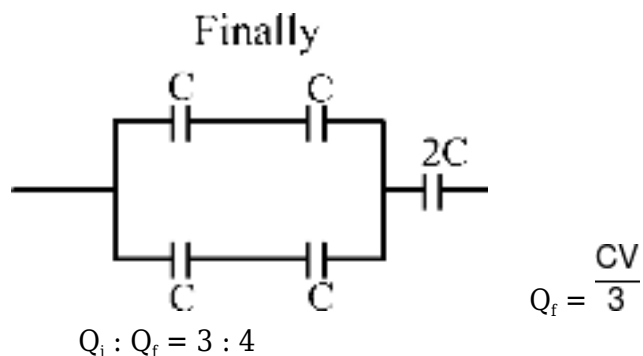


$$Q \text{ initially} = \frac{CV}{4}$$

Q finally =



$$Q_i = \frac{CV}{4}$$



28) **Explain the Question :** In the given diode circuit, we have to calculate the potential difference between A and B.

Concept : This question is based on biasing of diodes and ohm's law.

Solution : Since diode in forward bias so it offers no resistance to flow of current.

□ equivalent resistance of circuit

$$= \left(10 + \frac{10 \times 10}{10 + 10} \right) \text{ k}\Omega = 15 \text{ k}\Omega$$

$$\square \text{ current through cell} = \frac{30\text{V}}{15\text{k}\Omega} = 2 \text{ mA}$$

$$\square \text{ current between A and B} = 1 \text{ mA}$$

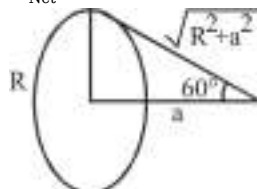
$$\square V_{AB} = 10 \text{ k}\Omega \times 1 \text{ mA} = 10 \text{ V}$$

Final answer : 3

29)

$$E_{\text{Net}} = E_{\text{infinite}} - E_{\text{disc}}$$

$$E_{\text{Net}} = \frac{\sigma}{2\epsilon_0} - \left[\frac{\sigma}{2\epsilon_0} - \frac{\sigma a}{2\epsilon_0 \sqrt{R^2 + a^2}} \right]$$

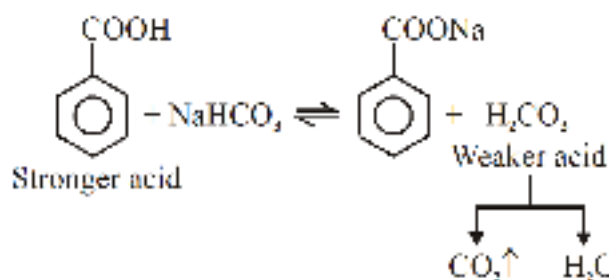


$$E_{\text{Net}} = \frac{\sigma}{4\epsilon_0}$$

$$30) \quad mg(h+y) = \frac{1}{2}ky^2 \Rightarrow mg(h+y) = \frac{mg}{4h}y^2$$

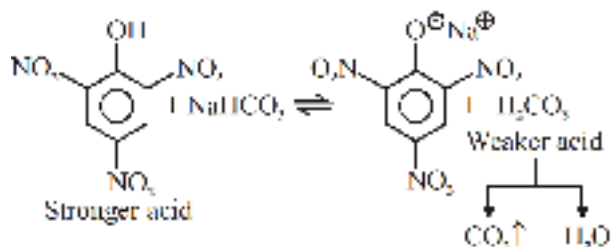
$$y^2 - 4hy - 4h^2 = 0 \Rightarrow y_{\text{max}} = 2h(\sqrt{2} + 1).$$

CHEMISTRY

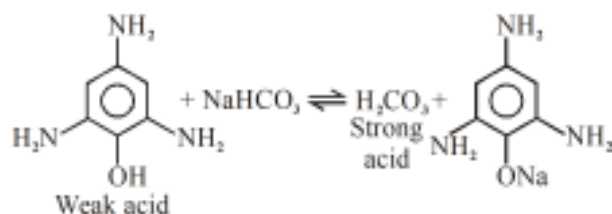


31)

equilibrium favours forward direction and CO_2 is liberated.



Equilibrium favours forward direction and CO_2 is liberated.

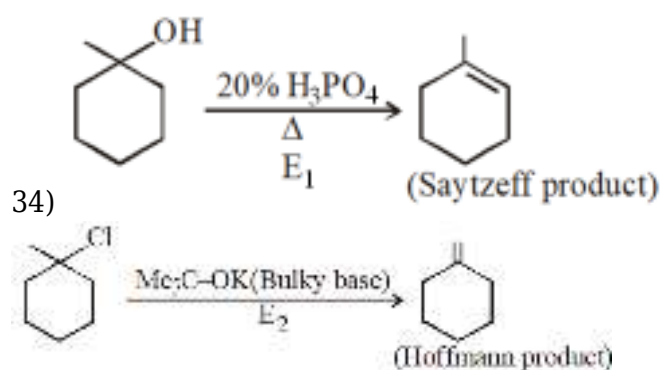


Equilibrium favours back word direction and CO_2 is not liberated.

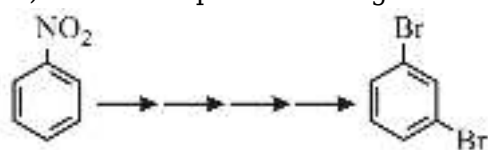
32) Staggered and eclipsed conformers of ethane also known as rotamers

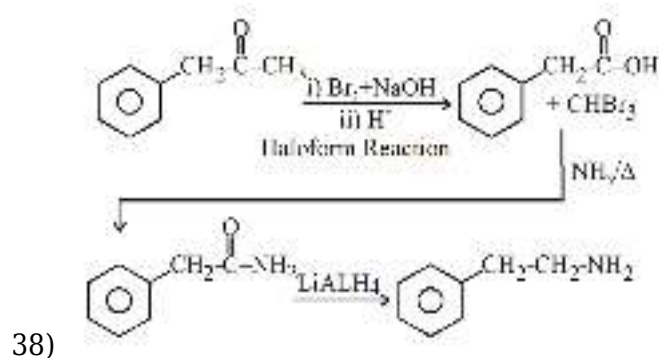
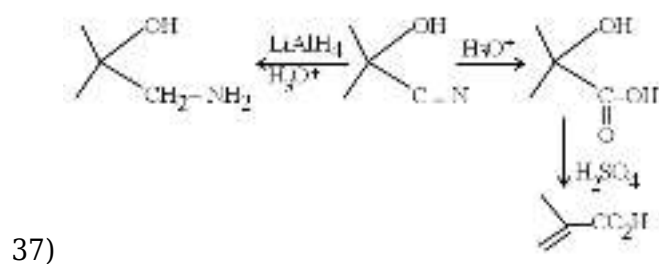
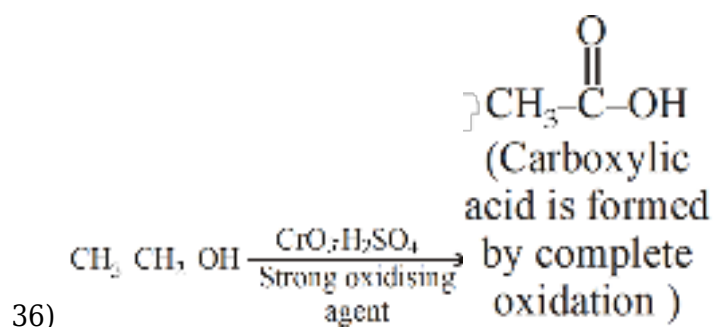
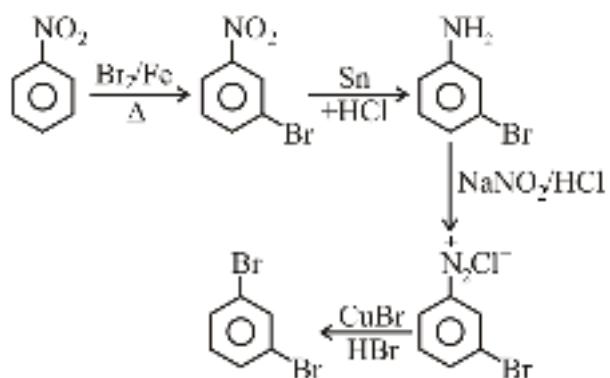
33)

The correct answer option is (C)



35) Correct sequence of reagents for the following conversion.





⇒ This reaction does not involve haffmann bromanide degradation.

⇒ Rest all options involve haffmann bromamide degradation during the reaction of $\text{Br}_2 + \text{NaOH}$ with amide.

39) (1) Sucrose → α-D-Glucose and β-D-Fructose

(2) Lactose → β-D-Galactose and β-D-Glucose

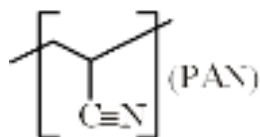
(3) Maltose → α-D-Glucose and α-D-Glucose

a → II

b → I

c → III

40) → orlon fibers are made up of Polyacrylonitrile



41)

Explanation Question: Question is asking about difference in wavelength of first and last line of Lyman series for H^+ .

Concept: This question is based on atomic line spectrum.

Solution: Wave length = $\frac{1}{\text{Wave number}}$

Wave number for a line in spectrum

$$\bar{\nu} = RZ^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$$

$Z = 2$ Lyman series $n_1 = 1$

First line $n_2 = 2$, last line $n_2 = \infty$

$$\bar{\nu}_{L_1} = R_H 2^2 \left[\frac{1}{1^2} - \frac{1}{2^2} \right] = 4R_H \times \frac{3}{4} = \lambda_{L_1} = \frac{1}{3R_H}$$

$$\bar{\nu}_{L_{\text{Last}}} = R_H 2^2 \left[\frac{1}{1^2} - \frac{1}{\infty^2} \right] = 4R_H = \lambda_{L_{\text{Last}}} = \frac{1}{4R_H}$$

$$\text{So, } \lambda_{L_1} - \lambda_{L_{\text{Last}}} = \frac{1}{3R_H} - \frac{1}{4R_H} = \frac{1}{12R_H}$$

Final Answer: Option (1). $\frac{1}{12R_H}$

42) **Question Explanation:**

Calculate K_C for $\text{NO}_2 \rightleftharpoons \text{NO} + \frac{1}{2}\text{O}_2$

Concept:

Application of equilibrium constant.

Solution:

$$K_C = \frac{k_f}{k_b} = \frac{2 \times 10^3}{20} = 100$$

$$K_c = \frac{1}{\sqrt{K_C}} = \frac{1}{\sqrt{100}} = 0.1$$

Final Answer: Option: (3)

44)

Conceptual.

45) Question Explanation:

Calculate rate law for the reaction.

Concept:

This question is based on rate law for reaction.

Solution:

$A + B \rightarrow \text{product}$

rate law $r = K[A]^x [B]^y$ (1)

from experiment 2r = $K[A]^x [2B]^y$ (2)

from experiment 8r = $K[2A]^x [2B]^y$ (3)

from (2)/(1) $2 = 2^y \Rightarrow y = 1$

from (3)/(2) $4 = 2^x \Rightarrow x = 2$

then rate law $r = K[A]^2 [B]$

Final Answer:

The correct option is (4)

47)

Question Explanation: We have to find out mole composition of mixture.

Concept: This question is based on enthalpy of reaction.

Solution:

energy released w. r. t. $\frac{1}{2}$ mole $O_2 = 110 \text{ KJ}$

energy released w. r. t. n_1 mole $O_2 = (220 \times n_1)$

energy consumed w. r. t. 1 mole steam = 132KJ

energy consumed w. r. t. n_2 mole steam = $132 \times n_2$

$220 \times n_1 = 132 \times n_2$

$$\frac{n_1}{n_2} = \frac{132}{220} = \frac{0.6}{1}$$

Final Answer:

option (1)

48)

Explanation Question: Find volume of 0.2M RNH_3Cl

Concept: This question is based on Buffer solution

Solution: Ozonolysis

$$P_{\text{Ob}} = P_{\text{Kb}} + \log \frac{[RNH_3Cl]}{[RNH_2]}$$

$$14 - 8.7 = 5 + \log \left(\frac{0.2 \times V}{0.1 \times 100} \right)$$

$$0.3 = \log 2 = \log \left(\frac{0.2 \times V}{10} \right)$$

$$\frac{0.2 \times V}{10} = 2$$

$$V = 100 \text{ ml}$$

Final Answer

The correct option is (2)

49)

Ans : (2)

$$K = 0.0112 \Omega^{-1} \text{ cm}^{-1}$$

$$R = 55 \Omega$$

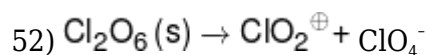
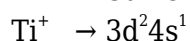
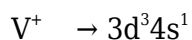
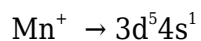
$$\square GG^* = K$$

$$\frac{1}{55} \times G^* = 0.0112$$

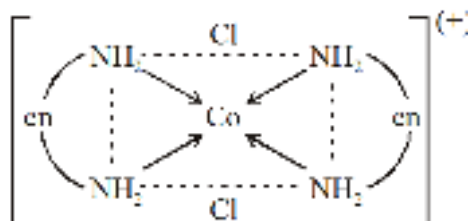
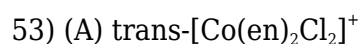
$$G^* = 0.616 \text{ cm}^{-1}$$

50) More will be the +ve charge more is the precipitating power.

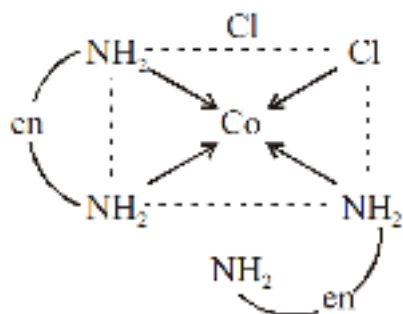
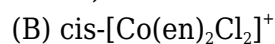
51)



(Bent/v-shape / angular shape)



$\Rightarrow$ (A) is trans form and shows plane of symmetry which is optically inactive (not optically active)



⇒ (B) is cis form and does not show plane of symmetry, hence it is optically active.

54)

Solution: Wolframite (FeWO_4) is magnetic

55)

(A) Polarisability of Anion $\propto$ Charge on Anion $\propto$ Size of anion

(B), (D) According to inner / Pair effect down the group lower 0.5 will be stable.

(C) Lewis acid character $\Rightarrow \text{BF}_3 < \text{BCl}_3$ due to back-bonding.

56) $\text{AgNO}_2 \rightarrow$ colourless $\text{CuBO}_2 \rightarrow$ colourless $\text{Ag}_3\text{PO}_4 \rightarrow$ yellow

57) Order of thermal stability :

$\text{Li}_2\text{CO}_3 < \text{Na}_2\text{CO}_3 < \text{K}_2\text{CO}_3 < \text{Rb}_2\text{CO}_3$

58)

When Cl_2 is passed over slaked lime $[\text{Ca}(\text{OH})_2]$, then bleaching powder is formed which is represented as $\text{Ca}(\text{OCl})_2 + \text{CaCl}_2 + \text{Ca}(\text{OH})_2 \cdot \text{H}_2\text{O}$ or CaOCl_2 . Hence, choice (C) is correct while (A), (B) and (D) are incorrect.

59) Einsteinium (atomic No = 99) : $[\text{Rn}] 5f^{11} 6d^0 7s^2$

60) ${}_1\text{H}^1 \Rightarrow$ Protium , ${}_1\text{H}^2 \Rightarrow$ Deuterium , ${}_1\text{H}^3 \Rightarrow$ Tritium

ENGLISH PROFICIENCY

61) The correct answer is (1)

62) The correct answer is (1)

63) The correct answer is (3)

64) The correct answer is (3)

65) The correct answer is (2)

66) The correct answer is (2)

67) The correct answer is (2)

68) The correct answer is (3)

69) The correct answer is (2)

70) The correct answer is (4)

LOGICAL REASONING

71) The correct answer is (2)

72) The correct answer is (3)

73) The correct answer is (2)

74) The correct answer is (2)

75) The correct answer is (4)

76) The correct answer is (1)

77) The correct answer is (4)

78) The correct answer is (2)

79) The correct answer is (3)

80) The correct answer is (4)

81) The correct answer is (3)

82) The correct answer is (2)

83) The correct answer is (3)

84) The correct answer is (1)

85) The correct answer is (3)

86) The correct answer is (1)

87) The correct answer is (3)

88) The correct answer is (2)

89) The correct answer is (4)

90) The correct answer is (1)

MATHEMATICS

91)

$$\tan 22^\circ + \tan 23^\circ = -p$$

$$\tan 22^\circ \tan 23^\circ = q$$

$$p - q = -(\tan 22^\circ + \tan 23^\circ) - \tan 22^\circ \tan 23^\circ$$

$$= -[\tan 22^\circ + \tan 23^\circ + \tan 22^\circ \tan 23^\circ]$$

$$= -[(1 + \tan 22^\circ)(1 + \tan 23^\circ) - 1]$$

$$= -[2 - 1] = -1$$

92)

$$x - 2 \neq 0, x - 3 \neq 0 \text{ and}$$

$$|x - 3| = 1 \text{ or } x^2 - 8x + 5 = 0$$

$$x = 2, 4 \text{ or } (x - 3)(x - 5) = 0$$

$$x = 3, 5$$

$$\square x = 4, 5$$

$$93) \alpha^2 + \sqrt{2} = -2^{1/4} \alpha$$

$$\Rightarrow \alpha^4 + 2\sqrt{2}\alpha^2 + 2 = \sqrt{2}\alpha^2 \text{ (on squaring)}$$

$$\Rightarrow \alpha^4 + 2 = -\sqrt{2}\alpha^2$$

$$\Rightarrow \alpha^8 + 2\alpha^4 + 4 = 0 \text{ (on squaring)}$$

$$\Rightarrow \alpha^8 = -2\alpha^4 - 4$$

$$\Rightarrow \alpha^{12} = -2\alpha^8 - 4\alpha^4 = -2(-2\alpha^4 - 4) - 4\alpha^4 = 2^3$$

$$\Rightarrow \alpha^{96} = 2^{24}$$

$$\text{Similarly } \beta^{12} = 2^3 \text{ \& } \beta^{96} = 2^{24}$$

$$\text{So } \alpha^{96}(\beta^{12} - 1) + \beta^{96}(\alpha^{12} - 1) = 2(2^{24} \times (7))$$

$$= 7 \times 2^{25}$$

$$94) \text{ The given equation is } (Z^2 + Z + 1)(Z^2 + 1) = 0$$

$$\therefore Z = w, w^2, i, -i \Rightarrow |Z| = 1$$

95)

$$\begin{aligned} \text{by expanding} &= 4(z_1^2 + z_2^2 + z_3^2) \\ &= 4(1 + 4 + 9) \\ &= 56 \end{aligned}$$

$$96) {}^{15}C_{3r} : {}^{15}C_{r+1} = 11 : 3$$

Clearly, V can be 0, 1, 2, 3, 4, 5 but possibilities of $r = 0$ or 5 are clearly ruled out (as ${}^{15}C_0 = {}^{15}C_{15} = 1$).

For $r = 1$,

$${}^{15}C_{3r} = {}^{15}C_3 = \frac{15 \times 14 \times 13}{6} \quad \text{and} \quad {}^{15}C_{r+1} = {}^{15}C_2 = \frac{15 \times 14}{2}$$

$$\square {}^{15}C_{3r} : {}^{15}C_{r+1} = 13:3$$

For $r = 2$,

$$\begin{aligned} {}^{15}C_{3r} &= {}^{15}C_6 = \frac{15 \times 14 \times 13 \times 12 \times 11 \times 10}{6 \times 5 \times 4 \times 3 \times 2 \times 1} \\ {}^{15}C_{r+1} &= {}^{15}C_3 = \frac{15 \times 14 \times 13}{6} \end{aligned}$$

$$\square {}^{15}C_{3r} : {}^{15}C_{r+1} \neq 11:3$$

For $r = 3$,

$$\begin{aligned} {}^{15}C_{3r} &= {}^{15}C_9 = \frac{15 \times 14 \times 13 \times 12 \times 11 \times 10}{6 \times 5 \times 4 \times 3 \times 2 \times 1} \\ {}^{15}C_{r+1} &= {}^{15}C_4 = \frac{15 \times 14 \times 13 \times 12}{4 \times 3 \times 2 \times 1} \end{aligned}$$

$$\square {}^{15}C_{3r} : {}^{15}C_{r+1} = 11:3$$

For $r = 4$,

$$\begin{aligned} {}^{15}C_{3r} &= {}^{15}C_{12} = {}^{15}C_3 = \frac{15 \times 14 \times 13}{3 \times 2 \times 1} \\ {}^{15}C_{r+1} &= {}^{15}C_5 = \frac{15 \times 14 \times 13 \times 12 \times 11}{5 \times 4 \times 3 \times 2 \times 1} \end{aligned}$$

$$\square {}^{15}C_{3r} : {}^{15}C_{r+1} = 5:33$$

Thus, $r = 3$.

97) There can be two types of committees

(i) containing 3 men and 3 ladies

(ii) containing 2 men and 4 ladies

$\square$ Required number of ways

$$= {}^8C_3 \times {}^4C_3 + {}^8C_2 \times {}^4C_4$$

98)

$$S = S_{3n} - S_{2n}$$

$$S = \frac{n}{2} [2a + (5n - 1)d]$$

Now sum of 5n terms will be

$$\frac{5n}{2} [2a + (5n - 1) d]$$

Now sum of 5n terms will be

$$\frac{5n}{2} [2a + (5n - 1) d] = 5S$$

$$99) \frac{A_{200}}{A_{100}} = \frac{A_{400}}{A_{200}} = \frac{A_{200} - A_{400}}{A_{100} - A_{200}} = 2$$

$$\begin{aligned} 100) \quad S &= 1 + 2\left(1 + \frac{1}{50}\right) + 3\left(1 + \frac{1}{50}\right)^2 + \dots + 50\left(1 + \frac{1}{50}\right)^{49} \\ \left(1 + \frac{1}{50}\right) S &= \left(1 + \frac{1}{50}\right) + 2\left(1 + \frac{1}{50}\right)^2 + \dots + 49\left(1 + \frac{1}{50}\right)^{49} + 50\left(1 + \frac{1}{50}\right)^{50} \\ \frac{-S}{50} &= \underbrace{1 + \left(1 + \frac{1}{50}\right) + \left(1 + \frac{1}{50}\right)^2 + \dots + \left(1 + \frac{1}{50}\right)^{49}}_{50 \text{ terms}} - 50\left(1 + \frac{1}{50}\right)^{50} \\ \frac{-S}{50} &= \frac{\left(\left(1 + \frac{1}{50}\right)^{50} - 1\right)}{\frac{1}{50}} - 50\left(1 + \frac{1}{50}\right)^{50} \\ \frac{-S}{50} &= 50\left(1 + \frac{1}{50}\right)^{50} - 50 - 50\left(1 + \frac{1}{50}\right)^{50} \\ S &= 50 \times 50 \\ S &= 2500 \\ \text{Ans. (A)} \end{aligned}$$

$$\begin{aligned} 101) \quad &\sum_{n=2}^{\infty} \tan^{-1} \left(\frac{\sqrt{3}}{2n^2 + 1} \right) \\ &= \sum_{n=2}^{\infty} \tan^{-1} \left[\frac{2\sqrt{3}}{4n^2 + 2} \right] \\ &= \sum_{n=2}^{\infty} \tan^{-1} \left[\frac{2\sqrt{3}}{3 + (2n+1)(2n-1)} \right] \\ &= \sum_{n=2}^{\infty} \tan^{-1} \left[\frac{\frac{2}{\sqrt{3}}}{1 + \left(\frac{2n+1}{\sqrt{3}}\right)\left(\frac{2n-1}{\sqrt{3}}\right)} \right] \\ &= \sum_{n=2}^{\infty} \left[\tan^{-1} \left(\frac{2n+1}{\sqrt{3}} \right) - \tan^{-1} \left(\frac{2n-1}{\sqrt{3}} \right) \right] \\ &= \frac{\pi}{2} - \tan^{-1}(\sqrt{3}) = \frac{\pi}{6} \end{aligned}$$

$$102) \quad 2 \left\{ {}^6C_0 x^6 + {}^6C_2 x^4 (\sqrt{x^2 - 1})^2 + {}^6C_4 x^2 (\sqrt{x^2 - 1})^4 + {}^6C_6 (\sqrt{x^2 - 1})^6 \right\}$$

$$2 \left\{ x^6 + 15x^4 (x^2 - 1) + 15x^2 (x^4 - 2x^2 + 1) + (x^6 - 3x^4 + 3x^2 - 1) \right\}$$

$x^6, x^4, x^2, 1 \rightarrow 4 \text{ terms}$

$$103) \tan A \tan(60^\circ - 3A) \tan(60^\circ + A) \tan(60^\circ + 3A) = 1$$

$$\frac{\tan A \tan(60^\circ - A) \tan(60^\circ + A)}{\tan(60^\circ - A)} \cdot \frac{\tan 3A \tan(60^\circ - 3A) \tan(60^\circ + 3A)}{\tan 3A} = 1$$

$$\tan(9A) = \tan(60^\circ - A)$$

$$9A = n\pi + \frac{\pi}{3} - A$$

$$10A = n\pi + \frac{\pi}{3} \quad A = \frac{\pi}{30}, \frac{4\pi}{30}, \frac{7\pi}{30}$$

104)

Question Explanation: Finding the number of integers k making the x -coordinate an integer.

Concept: Intersection of lines and divisibility of integers.

Solution:

The given lines are

$$3x + 4y = 9 \quad \dots(1)$$

$$\text{and } y = mx + 1 \quad \dots(2)$$

Solving (1) and (2), we get the x -coordinate of the point of intersection as $x = \frac{5}{4m+3}$

Since x -coordinate is an integer,

$$\square 4m + 3 = \pm 5 \text{ or } 4m + 3 = \pm 1$$

Solving these, only integer values of m are -1 and -2

$$\square m = -1, -2$$

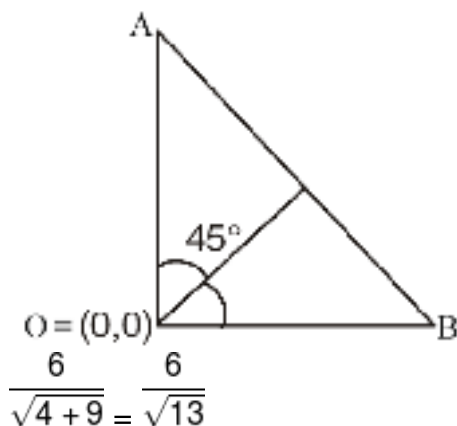
The number of integral values of $k = 2$

Final Answer: Option (1)

105)

Let AB is $2x + 3y - 6 = 0$

Distance of $(0, 0)$ from the line $2x + 3y - 6 = 0$



$$\therefore \text{Area of the triangle is } \left(\frac{6}{\sqrt{13}} \right)^2 = \frac{36}{13}$$

$$106) \cos 60^\circ = \frac{CP}{2} \Rightarrow CP^2 = 4\cos^2 60^\circ$$

$$\Rightarrow CP^2 = 1$$

$$(h-1)^2 + (k-1)^2 = 1$$

$$\Rightarrow x^2 + y^2 - 2x - 2y + 1 = 0$$

$$107) \text{Area} = \frac{2a^2}{e}$$

$$108) \text{ We know that the line } y = mx + c \text{ touches the hyperbola } \frac{x^2}{a^2} - \frac{y^2}{b^2} = 1, \text{ if } c^2 = a^2 m^2 - b^2$$

$$\text{The given hyperbola and the line are } \frac{x^2}{5} - \frac{y^2}{9} = 1$$

$$\text{and } y = 3x + \lambda$$

$$\text{Here, } a^2 = 5, b^2 = 9, m = 3$$

$$\therefore \lambda = \sqrt{a^2 m^2 - b^2} = \sqrt{45 - 9} = \sqrt{36} = 6$$

$$109) \sin x + \cos x = t$$

$$1 + \sin 2x = t^2$$

$$\sin 2x = t^2 - 1$$

$$\lim_{t \rightarrow \sqrt{2}} \frac{8\sqrt{2} - t^7}{\sqrt{2} - \sqrt{2}(t^2 - 1)}$$

$$\lim_{t \rightarrow \sqrt{2}} \frac{8\sqrt{2} - t^7}{2\sqrt{2} - \sqrt{2}t^2} \text{ (L-Hospital Rule)}$$

$$\lim_{t \rightarrow \sqrt{2}} \frac{-7t^6}{-2\sqrt{2}t} = \lim_{t \rightarrow \sqrt{2}} \frac{7}{2\sqrt{2}} \times t^5$$

$$= \frac{7}{2\sqrt{2}} \times (\sqrt{2})^5 = 14$$

$$110) p \rightarrow (q \vee r) \text{ is false}$$

$$\text{when } p \text{ is T}$$

$$\text{and } q \vee r \text{ is false}$$

$$\text{when both } r \text{ \& } q \text{ are false}$$

$$\therefore \text{Truth values are T F F}$$

$$111) \sum_{i=1}^{10} (x_i - 5) = 10$$

$$\Rightarrow \text{Mean of observation } x_i - 5 = \frac{1}{10} \sum_{i=1}^3 (x_i - 5) = 1$$

$$\Rightarrow \mu \text{ mean of observation } (x_i - 3)$$

$$= (\text{mean of observation } (x_i - 3))$$

$$= 1 + 2 = 3$$

$$\text{Variance of observation}$$

$$x_i - 5 = \frac{1}{10} \sum_{i=1}^{10} (x_i - 5)^2 - (\text{Mean of } (x_i - 5))^2$$

$\Rightarrow \lambda = \text{variance of observation } (x_i - 3)$
 $= \text{variance of observation } (x_i - 5) = 3$
 $\therefore (\mu, \lambda) = (3, 3)$

112) $100 \geq 73 + 65 - x$
 $x \geq 138 - 100 \Rightarrow x \geq 38$

113) Reflexive: $(x, x) \in R$
Symmetric: $(\sqrt{2}, 1) \in R$ But $(1, \sqrt{2}) \notin R$
Transitive: $(1, \sqrt{3})$ and $(\sqrt{3}, \sqrt{2}) \in R$
But $(1, \sqrt{2}) \notin R$

114) $A = \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$
 $P = \begin{pmatrix} \cos \theta & \sin \theta \\ -\sin \theta & \cos \theta \end{pmatrix} \Rightarrow PP^T = I$
 $Q = P^T A P$
 $Q^2 = (P^T A P) (P^T A P)$
 $Q^2 = P^T A^2 P$
 $PQ^{2014}P^T = P^T (P A^{2014} P^T) P = A^{2014}$
 $A^2 = \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix} = \begin{pmatrix} 1 & 4 \\ 0 & 1 \end{pmatrix}$
 $A^3 = \begin{pmatrix} 1 & 4 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix} = \begin{pmatrix} 1 & 2.3 \\ 0 & 1 \end{pmatrix}$
 $A^{2014} = \begin{pmatrix} 1 & 4028 \\ 0 & 1 \end{pmatrix}$

115) $A = A^T, B = B^T, C^T = -C$
 $D = ABC - CBA \dots (i)$
 $D^T = C^T B^T A^T - A^T B^T C^T$
 $D^T = -CBA + ABC \dots (ii)$
from (i) & (ii), $D = D^T \Rightarrow D$ is symmetric matrix

116)

$|\text{adj adj adj adj adj } (2A)| = |2A|^{(3-1)^5}$
if $|A| = 2$ so $|2A| = 16$
 $\Rightarrow (16)^{32} = (24)^{32} = 2^{128}$

117)

Question Explanation: Finding values of a for which a system of linear equations has no solution.

Concept: Cramer's Rule and Determinants for System of Equations.

Solution:

1. Set the coefficient determinant $\Delta = 0$:

$$\Delta = \begin{vmatrix} a & 1 & 1 \\ 1 & a & 1 \\ 1 & 1 & a \end{vmatrix} = (a+2)(a-1)^2 = 0$$

This gives $a = 1$ or $a = -2$.

B. Check $a = 1$: All three equations become $x + y + z = 0$. This system represents the same plane, leading to infinitely many solutions.

C. Check $a = -2$: The equations become:

$$-2x + y + z = -3$$

$$x - 2y + z = -3$$

$$x + y - 2z = -3$$

Adding these gives $0 = -9$, which is impossible. Thus, there is no solution.

Final Answer: Option(2)

$$\begin{aligned} f(x) &= \log_2 \left(\underbrace{\frac{1}{\sqrt{2}} \sin x - \frac{1}{\sqrt{2}} \cos x + 3}_{\text{range } [2, 4]} \right) \\ &= \log_2 [2, 4] \\ &= [\log_2 2, \log_2 4] \\ \text{Range} &= [1, 2] \end{aligned}$$

$$119) f(x) = \frac{\alpha x}{x+1}, \quad x \neq -1$$

$$f(f(x)) = x \Rightarrow \frac{\alpha \left(\frac{\alpha x}{x+1} \right)}{\frac{\alpha x}{x+1} + 1} = x$$

$$\Rightarrow \frac{\alpha^2 x}{(\alpha + 1)x + 1} = x$$

$$\Rightarrow (\alpha + 1)x^2 + (1 - \alpha^2)x = 0 \quad (1)$$

$$\Rightarrow \alpha + 1 = 0 \text{ and } 1 - \alpha^2 = 0$$

[As true $\forall x \neq -1$ $\square$ Eq. (1) is an identity]

$$\Rightarrow \alpha = -1.$$

120)

Given $f(x) = \frac{-x}{2} + \sin x$

$$f'(x) = -\frac{1}{2} + \cos x$$

$$\square \quad \frac{-\pi}{3} < x < \frac{\pi}{3} \Rightarrow \frac{1}{2} < \cos x < 1$$

$$\Rightarrow 0 < -\frac{1}{2} + \cos x < \frac{1}{2}$$

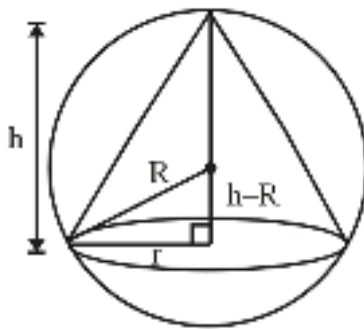
$\square$ Function is increasing in the given interval

$$y = \sin^{-1} \left(\frac{1-x^2}{1+x^2} \right)$$

Put $x = \tan \theta \Rightarrow \theta = \tan^{-1} x$

$$\therefore y = \sin^{-1} \cos 2\theta = \frac{\pi}{2} \pm 2\theta$$

121) $y = \frac{\pi}{2} \pm 2 \tan^{-1} x \Rightarrow \frac{dy}{dx} = \frac{\pm 2}{1+x^2}$



122)

$$R^2 = r^2 + (h - R)^2$$

$$r = \sqrt{2Rh - h^2}$$

$$\text{volume of cone} = \frac{1}{3} \pi r^2 h$$

$$= \frac{1}{3} \pi h (2Rh - h^2)$$

$$V = \frac{\pi}{3} (2Rh^2 - h^3)$$

$$\Rightarrow \frac{dV}{dh} = \frac{\pi}{3} (4Rh - 3h^2) = 0$$

$$\Rightarrow R = \frac{3h}{4} \Rightarrow \frac{h}{R} = \frac{4}{3}$$

$$\Rightarrow \frac{h}{2R} = \frac{2}{3} \text{ for max volume.}$$

123) Ans. (3)

Put $\cos y = t$

$$\frac{dt}{dx} = -\sin y \frac{dy}{dx}$$

$$\Rightarrow \frac{dt}{dx} - \frac{t}{x} = -x^4 t^2$$

$$\frac{1}{t^2} \frac{dt}{dx} - \frac{1}{tx} = -x^4$$

$$\text{put } -\frac{1}{t} = z \Rightarrow \frac{dz}{dx} = \frac{1}{t^2} \frac{dt}{dx}$$

$$\frac{dz}{dx} + \frac{z}{x} = -x^4 \Rightarrow zx = -\frac{x^6}{6} + c$$

$$x(\sec y) = \frac{x^6}{6} + c$$

124) $e^x = y$

$$\begin{aligned} \Rightarrow I &= \int \frac{2y+1}{(3y+1)(y-1)} dy = \frac{3}{4} \int \frac{dy}{y-1} - \frac{1}{4} \int \frac{dy}{3y+1} \\ &= \frac{3}{4} \ln|y-1| - \frac{1}{12} \ln|3y+1| + C \end{aligned}$$

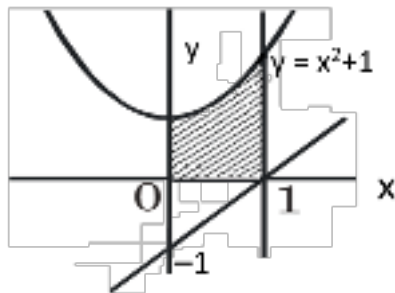
$$f(x) = \int_0^{\sin^2 x} \sin^{-1} \sqrt{t} dt + \int_0^{\cos^2 x} \cos^{-1} \sqrt{t} dt$$

$$f'(x) = \sin^{-1} \sqrt{\sin^2 x} \cdot (2 \sin x \cos x) + \cos^{-1} \sqrt{\cos^2 x} \cdot (-2 \sin x \cos x)$$

$$f'(x) = 0 \Rightarrow f(x) = c$$

$$f\left(\frac{\pi}{4}\right) = \int_0^{\frac{1}{2}} \frac{\pi}{2} dx = \frac{\pi}{4}, f(x) = \frac{\pi}{4}$$

126) **Solution:**



$$\text{Area} = \int_0^1 (x^2 + 1) dx + \frac{1}{2} \times 1 \times 1 = \left(\frac{x^3}{3} + x \right) \Big|_0^1 + \frac{1}{2}$$

$$\frac{1}{3} + 1 + \frac{1}{2} = \frac{11}{6}$$

Final Answer: Option (1)

$$\begin{aligned}
 127) \quad \vec{c} &= \lambda \left(\frac{\vec{a}}{2} + \vec{b} \right) \\
 |\vec{c}| &= \lambda \sqrt{\frac{|\vec{a}|^2}{4} + |\vec{b}|^2 + 2 \left| \frac{\vec{a}}{2} \right| \cdot |\vec{b}| \cdot \cos 120^\circ} \\
 4 &= \lambda \sqrt{1 + 1 + 2 \cdot 1 \cdot \left(-\frac{1}{2} \right)} \\
 \Rightarrow \lambda &= 4 \\
 \text{So, } \vec{c} &= 2\vec{a} + 4\vec{b}
 \end{aligned}$$

$$128) \quad [\vec{a} \ \vec{b} \ \vec{c}] = 0 \Rightarrow \begin{vmatrix} 1 & 1 & 1 \\ 4 & 3 & 4 \\ 1 & \alpha & \beta \end{vmatrix} = 0$$

$$\begin{aligned}
 &\Rightarrow 1(3\beta - 4\alpha) - 1(4\beta - 4) + 1(4\alpha - 3) = 0 \\
 &\Rightarrow 3\beta - 4\alpha - 4\beta + 4 + 4\alpha - 3 = 0 \\
 &\Rightarrow -\beta + 1 = 0 \Rightarrow \beta = 1 \\
 \text{Now, } |\vec{c}| &= \sqrt{3} \text{ (given)} \\
 \sqrt{1 + \alpha^2 + \beta^2} &= \sqrt{3} \\
 \Rightarrow 1 + \alpha^2 + \beta^2 &= 3 \\
 \Rightarrow 1 + \alpha^2 + 1 &= 3 \\
 \Rightarrow \alpha^2 = 1 &\Rightarrow \alpha = \pm 1
 \end{aligned}$$

$$\begin{aligned}
 129) \quad L_1 &\equiv \frac{x+1}{2} = \frac{y-2}{-1} = \frac{z-1}{1} \\
 L_2 &\equiv \frac{x+2}{\alpha} = \frac{y+1}{5-\alpha} = \frac{z+1}{1} \\
 \text{Point A} &(-1, 2, 1) \text{ B}(-2, -1, -1) \\
 \square L_1 \text{ and } L_2 &\text{ are coplanar}
 \end{aligned}$$

$$\Rightarrow \begin{vmatrix} 2 & -1 & 1 \\ \alpha & 5-\alpha & 1 \\ 1 & 3 & 2 \end{vmatrix} = 0$$

$$\alpha = -4$$

$$L_2 \equiv \frac{x+2}{-4} = \frac{y+1}{9} = \frac{z+1}{1}$$

Check options (2, -10, -2) lies on L_2

$$\begin{aligned}
 130) \quad ax^2 + bx + c &= 0 \\
 \text{For equal roots } D &= 0 \\
 \Rightarrow b^2 &= 4ac \\
 \text{Case I : } ac &= 1 \\
 (a, b, c) &= (1, 2, 1) \\
 \text{Case II : } ac &= 4 \\
 (a, b, c) &= (1, 4, 4)
 \end{aligned}$$

or (4, 4, 1)

or (2, 4, 2)

Case III : $ac = 9$

(a, b, c) = (3, 6, 3)

Required probability = $\frac{5}{216}$